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PHYSICS AND USES OF HIGH FREQUENCY CURRENTS*

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It is no more essential that a physician should understand the mechanics of a high frequency machine than those of his automobile. His sole interest is the successful application of the high frequency current in the treatment of pathological conditions, and he must of necessity leave the matters of its production to the manufacturers of electrical equipment. By a high frequency current we simply mean an alternating current of electricity wherein the current reverses itself very rapidly, the minimum being about 500,000 oscillations per second. This high frequency current in application produces within the tissues of the body a local elevation of temperature which has been termed diathermy. It is through the regulation and control of this thermic reaction that the physician determines his therapeutic effects. For convenience we speak of two kinds of diathermy, medical or constructive diathermy, and surgical or destructive diathermy, the dividing line being where stimulation ceases and disintegration begins.

In medical diathermy we have the ideal treatment for painful and infectious conditions, while in surgical diathermy we have that which is best adapted to the radical removal of neoplasms that are frankly or potentially malignant.

Diathermy is produced by the resistance of the tissues to the passage of a high frequency current and to be of value in therapeutics, the oscillation should be quite rapid. The latent period of a muscle contraction is approximately one-fiftieth of a second, but it has been found that oscillations as slow as 400,000 per second will produce uncomfortable faradic effects and this, of course, is to be avoided.

The average machine on the market today delivers from 800,000 to 1,000,000 oscillations per second, and some of the later type of machines will produce as high as 2,000,000.

The degree of temperature developed within the tissues is determined by five factors: first, the amperage employed; second, the frequency of the oscillations; third, the size of the electrodes; fourth, the resistance of the tissues; and, fifth, the time of application. The voltage or electro-motive force occupies the same position in diathermy that it does in x ray. It is the force that drives the electrons through the tissues and the only requirement is that it be sufficiently strong to insure a smoothly flowing current. It has been found difficult to con-

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struct a voltmeter that would register high frequency currents accurately, and as the voltage varies with the amperage, its proper determination is of no practical value. The amperage represents the size of the electrical discharge delivered to the patient and in medical diathermy we have what may be termed optimum amperages; by this we simply mean the number of milliamperes at which the best results are obtained in the treatment of a given condition.

I have several times published the average of these amperages as I have found them in practice. They vary, of course, with the machine and with the individual.

The resistance of the tissues is another factor to consider. Theoretically all other factors, such as voltage, amperage, resistance and so forth, being equal, a machine delivering 2,000,000 oscillations per second should heat tissue at least twice as rapidly as one delivering only 1,000,000, and this practically appears to hold true. The concentration of energy within the tissues is inversely proportioned to the size of the electrode; likewise the concentration at one electrode is inversely proportional to the relative size of the two electrodes. The resistance of the tissues is determined by two factors: first, the density of the tissues which increases, and the distance between the electrodes which diminishes the thermic effect. This being true, the dosage equals the milliamperes times the density, times the time divided by the thickness in centimeters of the tissue. With the current expressed algebraically, D equals M times R times T over D prime. D stands for dosage; M, for amperage; R, for density; T, for time; and D prime, for tissues. We then have

$$D = \frac{M \times R \times T.}{D'}$$

This, of course, has to be worked out for individual cases to get your statistics.

Just a word about amperage in surgical diathermy. In surgical diathermy the amperage is a relative thing. The number of milliamperes required to coagulate, to desiccate or to char tissue differs widely under different conditions and it is affected by the following factors: first, the type of tissue, whether it is soft or hard tissue, moist or dry, vascular or non-vascular; second, the resistance as determined by the distance between the electrodes and the density of the tissues; third, by the electrodes themselves as regards type and size, both actual and relative.

Just a word about types. You all know we have the sponge electrodes and the metal electrodes. Of course, the metal electrodes have supplanted the others almost entirely in practice. Bone heats quickly and retains its temperature for some time. This is due to the greater density and to the poor blood supply of the cortex and periosteal sheaths. The periosteum and muscle sheaths, tendons, facia and cicatricial tissue are tissues relatively non-vascular and heat very quickly. Fat is also a poor conductor of electrothermic energy. All highly vascular tissues are difficult to coagulate on account of the resultant heat being rapidly dispersed to the blood stream, and the presence of blood or other conducting fluids on the surface is absolutely contraindicated.

We can combat the increased vascularity of a neoplasm by increasing our amperage, but when blood appears on the surface, our operating electrode immediately becomes equivalent to an instrument with a treating surface the size of the blood covered field, and it is absolutely useless to proceed with the operation until the hemorrhage has been controlled. That is a point I wish you would all remember in doing electric surgery—have your field as dry as possible.

Medical or physiological diathermy is applicable in the treatment of painful and infectious conditions. It relieves pain; it combats infection; it hastens absorption and promotes repair. Medical diathermy has the advantage over external applications of heat in that the heat is generated within the tissues, whereas heat ap-

plied externally does not penetrate deeper than one-half an inch below the surface of the skin before being neutralized by the blood stream. Furthermore, with experience we learn to concentrate this thermic energy at any point within the body that we desire and may increase or decrease its intensity at will. In the relief of pain, diathermy has the same analgesic properties as that of heat applied externally. The use of heat in the relief of pain has been known since the earliest time and needs no discussion.

In combating infection, diathermy has both a direct and indirect action. We all know that there is an optimum temperature about that of the blood stream at whch bacteria thrive. Any marked variation from this optimum temperature produces a condition that is unfavorable to their propagation. This is especially true when the optimum temperature is exceeded. Nature attempts to combat infection within the human body by the elevation of general temperature that we term fever. However, this has the disadvantage of affecting the entire human body and on account of its effects on the higher brain centers it is of necessity quite limited in scope. General temperatures sufficient to produce an attenuation of most pathogenic bacteria are incompatible with life, and it is for this reason that diathermy is of so great a value in the treatment of local infections, it being possible to heat a considerable portion of the body to the point of cell coagulation and yet the general temperature not be elevated more than one-half of one degree.

In addition to this, diathermy has an indirect action, that is of equal or perhaps greattr value in therapeutics. Induced to a high temperature, there is a great influx of freshly oxygenated blood to the part. There is a concentration of agglutinins and other bacterial enzymes of the blood with a further attenuation of the bacteria and a raising of the opsonic index. There is also a marked inflow of phagocytes to the part, attracted by the vascular disturbance and by hematoxins. In addition to this, the heat and the healthy hyperemia favor repair. Fibroblasts are stimulated and healing proceeds.

Surgical or destructive diathermy is peculiarly adapted to the treatment of neoplasms that are frankly or potentially malignant. Its superiority over the scalpel lies in the fact that it prevents hemorrhage and by sealing the lymphatics and blood vessels removes the danger of cancer cell dissemination and metasatis. It also destroys bacteria and sterilizes the field and for this reason is useful in the treatment of old ulcers, carbuncles and in simple and infectious granuloma. In frankly benign growths, especially those about the face, surgical diathermy is inferior to the scalpel on account of the better cosmetic results that are obtained with the cold knife, but if there is any question of malignancy, diathermy becomes the agent of choice, supplemented, of course, by postoperative radium or x ray therapy.

X RAY THERAPY*

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X rays were discovered by Professor Roentgen, who died only a year and a half ago, in 1896. It was purely accidental. He was a physicist, experimenting with a Crooke's tube and energizing or lighting that tube by passing a current from an induction coil through the tube, noting the phenomena that took place in the lighting of the tube. After having performed some of the experiments, a few days later he went on a little walk and took along with him his camera to take some pictures. During the afternoon he made some exposures and was very much surprised when he developed those films to find he had the image of a large key on the plates that he had taken. Every one that was exposed had that key on it. Starting out to find why that should be, he developed some of the remaining plates that had not been exposed and found they had the image of the same key at the same location. He recognized the key because of its unusual shape as being an old key that he had had for some time and was using for a book mark in one of his books. That book was laying on the table. The tube with which he had been experimenting was above he book, and down underneath the table in a drawer were his photographic plates. So he repeated this experiment and found that there were rays emanating from that tube that had the power of penetrating opaque substances. He didn't know just what it was. It was something unknown to him and to physicists at that time. So he called them x rays, letting x equal the unknown.

Of more recent years, in an effort to standardize nomenclature and to give due credit to Professor Roentgen, we now call them Roentgen rays.

The past few years since paying more particular attention to the study of light, along with the roentgen ray and their biological effects, I have come to have an altogether different idea about light to what I formerly had. I like to think of light as being a form of energy that proceeds from the sun or some other luminous object. Artificial light is a form of energy. Only a small band or a small portion of the energy proceeding from the sun that affects the retina of the eye, which we know as light, just the same as there is only a small portion of the vibrations that are produced that affect the auditory nerve of the ear, which we know as sound.

This is true of the sun's ray, and it is true of x ray and also of radium. We speak of it and think of it as light, but it is energy and more than just light. We don't see x rays, so why should we call them light The only difference between x rays and the rays that proceed from the sun or from some other luminous object is a difference in their wave length. The wave length of the rays that we call light measured in Angstrom units, the unit of measurement, varies from 4,000 up to 8,000—4,000 at the upper end of the spectrum, which is the violet portion of light, and 8,000 at the other end, which is the red. You will remember when you studied physics you passed a beam of light through a prism of glass and you got all the colors of the rainbow, the seven different colors. The one at the top, the violet, is the one 4,000 Angstrom units long; the one at the bottom, the red, is 8,000 Angstrom units long. Below that we have vastly more rays which are energy that we know as infra red or heat rays. Still below that we have the Hertzian wave or radio wave. Going above the violet, we have first the ultra

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violet or the chemical ray of sunlight which we do not see. We generate this ray in the mercury quartz light, as we were told this morning. Clear beyond that, far beyond where there has been exploration or definite knowledge gained so far, we have the rays of x ray and radium, which instead of being 4,000 or 8,000 Angstrom units long are .02 up to 1.7; the length of the wave of x ray depending upon the voltage used in producing that ray.

X rays are a form of energy, the waves of which are so short that they do not affect the retina of the eye and we don't see them.

The x rays are projected down in this part of the tube.

In the discussion of radium Dr. Tyler mentioned the three different kinds of rays that emanate from radium—the alpha, the beta and the gamma ray. We can get practically the same identical ray from x ray, only in x ray we call them the hard and soft rays. The x ray produced by low voltage is the soft ray and is of long wave length and has but little penetrating power, while the ray produced by the high voltage x ray up to 200,000 volts is of shorter wave length and has a greater penetrating power.

We make use of x rays along therapeutic lines because of the action that they have upon the tissues, which is practically the same as was described to you in the discussion of radium. As the Doctor was discussing radium, I was made to feel somewhat like the Dago at a county fair who had a concession that he was trying hard to make pay, and the people right across from him had a concession of the same kind. It so happened the fellow across the aisle from him was a very glib talker and could display in a verbal way his product to a very good advantage and much to the chagrin of the Dago who had a very limited use of the English language. After he would get through with his harangue as to his product, the Dago would say, "The same ting over here." That is the way I felt when Dr. Tyler was discussing radium; about all I could do would be to say: "The same ting over here."

With x ray we have a definite set of factors that go to make up a dose of x ray. It is possible to deliver a definite dose of x ray just as definite and just as exact as a sixtieth of strychnin or a quarter of a grain of morphin, if these factors are observed. It is true that you have certain personal susceptibilities of the patient which vary just the same as you have in drugs. Some folks can not take the same dose of a drug as can others, and the same is true of x ray. Some can take a larger dose than others with perfect impunity. There are certain factors we must bear in mind in formulating our dose. First of all is the kilovoltage. That is the pressure behind the current that goes into the tube to produce the x ray. As we said, the higher the voltage or the kilovoltage, the harder the ray produced. The shorter its wave length, the more penetrating power it has. So if we want to penetrate a certain depth into the tissues and deliver a certain specified dose or quantity of x ray to the tissues at a certain depth, we vary our voltage accordingly.

Another factor is the milliamperage, the amount of current that goes into the thbe that will produce a like amoont or at least a certain amount of x ray. Another factor is the distance, the distance of the tube target, the point in the tube from which the x rays proceed to the skin of the patient, because as a general thing it is the skin of the patient that we are more concerned about. It is true with the higher voltage x ray and the heavier filter it is possible to produce rather extensive damage to the tissues underneath the skin and have the skin show but little effect of the x ray. As Dr. Tyler told you in a discussion of radium, the intensity of the dose varies inversely with the square of the distance. If you double the distance, the dose delivered with other factors remaining the same, is only one-fourth of what it would be with the distance decreased one-half.

The fourth factor is filter. As Dr. Tyler told you with radium, it is possible to filter out these softer rays and leave only the more powerful penetrating rays going into the tissues. That is not true 100 per cent, but we utilize it to the extent that we may protect the skin from the softer rays and deliver a heavy dose deeper down. Formerly we were using only the lower voltage, 130,000 to 140,000 volts. We didn't use such heavy filter and we placed our tube target closer to the patient with the result we were getting a maximum effect upon the skin and a less effect on the deeper tissues. This treatment is all right where you want to utilize so-called softer rays for superficial purposes for treating lesions upon the skin, but if you want to reach deeper into the tissues, say like carcinoma of the cervix or a prostate, you want higher voltage, something that will penetrate, will send a ray deeper into the tissues and not lose so much of its effect in the tissues above the point desired to be treated. So of late years we have been using x rays of higher voltage, 200 kilovolts, and increasing the filter and increasing the distance and increasing the other factor, which is time, thereby being able to deliver a more homogeneous dose to the deeper tissues with less danger of doing damage to the superficial tissues.

We now have the five factors that go to make up an x ray dose: Kilovolts, milliamperage, filter, distance and time. Vary any one of them and you vary your dose just as much as you would vary a dose of medicine if you threw part of it away. With the higher voltage we now use heavier filter, while we formerly used four to six millimeters of aluminum filter with one thickness of sole lether, we now have substituted copper and for our superficial work—when I say superficial I have in mind a breast, for instance, or a thyroid or a very thin patient with a fibroid—we only use a quarter-millimeter of copper filter, one-quarter millimeter of copper filter being equal to about seven of aluminum.

As we want to penetrate more tissue or go deeper into the tissues, we increase the filter because we are going to increase the time and for an individual with an average abdomen, most of our cases are treated with a half-millimeter of copper.

We have two distances, 20 and 24 inches. At a distance of 24 inches, using a millimeter of copper and one of aluminum, and the aluminum is always below the copper, we have been able to deliver 750 milliampere minutes to a single area without any apparent untoward effect upon the skin. When we say a dose of 750 milliampere minutes, that means five milliamperes for 150 minutes, two hours and a half. This dose is not all delivered at one time, but is broken up into maybe five half-hour doses or, as a usual thing, if the patient doesn't get too tired or is standing the treatment well, we may give even an hour at a time. We never give more than one hour's treatment at a time. When we have delivered the full dose of 750 milliampere minutes, that constitutes what we call one series of treatments. I know that is a rather large dose, I know that ordinarily we would expect to get a very decided erythema or a blistering. When my machine was checked up at different times by physicists, my limit of safety was placed at 600 milliampere minutes.

The question was asked a little while ago about the value of using actinic light in conjunction with radium therapy. I am not familiar with radium, but I believe I am with the x ray. I would not think of giving a so-callen erythema dose of x ray without preceding it with actinic, giving it along during the course of treatment and followng it for five to seven days. I feel sure in my own mind that it has perhaps at least in two instances saved me trouble. At one time unintentionally we delivered 900 milliampere minutes at a 24-inch distance with 200 kilovolts with one millimeter of copper filter. We followed that with actinic for about ten days. While the skin turned absolutely

black in about four weeks and remained so until it desquamated, it was never moist.

In another case, a case where we delivered 750 milliampere minutes and repeated the dose in sixty days, front and back. But very little change in the texture of the skin followed. It has now been two years since she received that dose. It was for a papillary carcinoma, very extensive. She has gained 70 pounds and thinks she is well. I don't know whether she is or not. I have never reached the point where I have been ready to say that I have ever cured cancer or carcinoma, because about the time you think you have, something comes up to prove to you that you have not. So we record our cases as having treated so many cases and so many are well after so long a time.

In discussing the relative value of radium and x ray (I believe that was the one thing that was left for me to discuss), the advantages of radium were mentioned to you and we certainly agree that for local application and in selected cases radium is to be preferred to x ray. However, as was stated to you, radium loses about 50 per cent of its efficiency after it penetrates one centimeter of tissue. If you deliver much of a dose of radium very far from the site of application, you are sure to have a necrosis, and a rather extensive one at the point of application, if much of a dose is delivered, we will say an inch or two inches away from the site of application. This, however, is not true with the high voltage x ray, it has the greater penetrating power and you can deliver a so-called carcinoma dose to the cervix or the prostate without producing any particular injurious effects upon the skin or adjacent tissues.

Given a case that is accessible for treatment by the x ray, I believe that it is just as efficient as radium. However, for local application such as the cervix where you want destructive action, somewhat localized, or for epitheliomas on the lip or on the skin anywhere where it is not necessary to have that penetrating dose to go so deep, it can be done just as well with radium and perhaps more conveniently. In some of our thy roid cases that are quite nervous and it is desired to administer a radiation treatment, you get away from the effect of putting the patient in the position under the x ray tube and certainly it is to be preferred, rather than having them lie down on a table for a half-hour or so and be more or less apprehensive as to what is going to happen to them during the course of the treatment.

It would seem that x rays are more particularly active upon cells that are either physiologically or biologically active. Dr. Tyler discussed with you the biologic action of radium. First of all, you have the action upon the endothelial lining of the blood vessels which become swollen and finally obliterated. It is in this manner that we produce a so-called x ray burn which is not a burn. That is a misnomer and should be changed to a postradiation reaction, or something of that sort. But because of the fact that after the blood supply has been cut off from the tissues and they have broken down and ulcerated and there is a large open sore, it has very much the appearance of a thermic burn, the term x ray burn has been applied. The thing that has really happened is that the rays have set up this reaction in the smaller blood vessels, producing an endarteritis obliterans and the blood supply is cut off and as a result the tissues die, just as you get a senile gangrene from endarteritis obliterans. After the blood supply is cut off you get a breaking down of the tissues and a sloughing. On the surface where it is completely cut off, the tissues are completely cast off, a little bit below the surface, there is still enough blood coming up to barely maintain life, and below that and lower still there is more and more blood supply and as you get deeper into the tissues finally there is enough blood supply there to maintain the life of the tissues and perhaps enable you to skin graft either with a flap or otherwise and heal the ulcer. That is a thing to bear in mind

in the treatment of x ray burns, that you must go deep enough into the tissues to get a blood supply that will not only support the tissues themselves but support the graft that you expect to graft on there to repair the damaged area if you choose to treat it in this manner. However, we believe there are other methods that are adequate and even better and in the end much more satisfactory, those of treating by physiotherapy means and light.

We said that x rays seem to exert their greatest influence upon cells that are either physiologically or biologically active. This is evidenced by the effect that x rays will have upon the thyroid. The thyroid is physiologically quite an active gland. The effect it will have on the testes and ovaries indicates the effect of rays on glands that are quite active physiologically. It has an effect on tumors. Tumors, either malignant or otherwise, contain many embryonic cells, cells dividing and subdividing with great rapidity, or, as we say, quite active in a biological way. Our x rays here exert their most pronounced effect.

We have three kinds of doses of x rays. A small dose of x ray is stimulative. You can deliver a larger dose and it becomes inhibitive to function. You can give still a larger dose where it may become destructive. In certain types of cases we simply want to deliver a stimulative dose, for instance in a chronic eczema. In some of the sycoses a stimulating dose is all that is required. In other classes of cases, as an example in women going through menopause with all the attendant nervousness, perhaps flooding, you can deliver an inhibitive dose to the ovaries and completely check their functioning and put the patients by their menopause within a very few weeks' time, rather than have them go over a period of years as they sometimes do. Some of my most grateful patients, I think, are patients of this class. I believe we can almost expect 100 per cent results in treating this class of cases. I know of no contraindication to the treatment and, as I say, it is a very, very gratified patient that you have following treatment of this class of case.

The destructive dose is the one used in treating malignancies and is sometimes spoken of as a carcinoma dose.

LEG ULCERS*
Their Treatment by Ultra Violet Radiation

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Ulcer of the leg, the bugaboo of the medical practitioner, stands at the top of the list of diseases causing disability and profound misery. A thorough study of this condition is warranted and any method that promises quicker relief than those current at the present time surely ought to be welcomed.

ETIOLOGY

"Ulcer of the leg" is a term which covers a variety of conditions and it is important that a diagnosis of the underlying cause be established before treatment be attempted. The two most common causes to which leg ulcers have been attributed have been varicose veins and syphilis. It is interesting to review the rather scant literature in reference to the etiology and I will present briefly a few of the conclusions.

R. Prosser White (1) summarized 69 cases of ulcer of the leg. Of these, 14 were males and 55 females. In the males the cause was quite obvious as follows: Syphilis, 6; trauma, or sepsis, 3; eczema, 4; tubercular, 1. Varicosity was present in the ratio of two to five. A history of trauma was usual. Female—of the 55 cases the great majority were married women, which leads to the assumption that there must be a disability due to being married, and he came to the conclusion that the disability was the bearing of children. His analysis of the 55 cases is as follows: Phlegmasia albadolens, 17; varicosity, 7; varicosity with the history of burst veins, 3; traumatic, 9; eczematous, 7; septic, 2; syphilitic, 5; scald, 1; tuberculous, 2; not diagnosed, 2.

John Homans (2) divided the causes into (a) varicosity, (b) trauma and infection; and so thorough was his study of the underlying causes of ulcer that I can do no better than to quote his work.

"In the case of the superficial veins of the legs, the delicacy of the mechanism by which blood is passed toward the heart makes the establishment of surface varicosity a not uncommon occurrence. Overstretching of the vein walls and destruction of the valves upon which the mechanism principally depends bring about a degree of surface stasis which obviously interferes with the nutrition of the skin and subcutaneous tissues. Under these conditions the healing of injuries, which is inefficient enough in otherwise normal dependent parts, is particularly unsatisfactory. It is to be expected, therefore, that skin which is bathed under pressure in stagnant venous blood will readily form permanent, open sores, or ulcers. Moreover, because of the arrangement of the principal surface veins of the leg, these ulcers must almost of necessity occur in, or near the middle half of the leg. The internal, or great saphenous vein, is a single channel in the thigh, but in the calf it divides into a number of large branches, each of which, when varicose, may be nearly as large as the parent trunk. The aggregate capacity of these branches must be considerably greater than that of the main channel in the thigh, and the flow of blood considerably slower. The middle and lower calf, being in the area of greatest stagnation, is, therefore, most liable to ulcer, while the foot is protected not so much by the habitual wearing of boots, as by the free communication which exists between the superficial and deep veins."

The influence of trauma and infection. Leg ulcers occur almost exclusively in those whose habits of life expose them to incessant work for long hours and whose surroundings and per-

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sonal hygiene are necessarily not of the best. Varicose ulcer is, in fact, incident to hard work or lack of cleanliness, or both, primarily a "poor man's disease," though varicose veins are not perhaps much less common in the well protected than among the needy. It is evident that the former find time and means to protect their skin from abrasion and infection, while the latter are unable to do so. The onset and course of ulcer does not depend, however, primarily upon such factors, but upon the character of the varicose veins, and can be most conveniently discussed under two headings: (1) Ulcers of surface varix, and (2) ulcers of surface varix complicated by varicosity of the perforating veins, including especially postphlebitic varix.

Ulcers of surface varix. The most familiar type of varix is that confined to the surface veins. It arises usually from heavy straining, lifting, and long hours of work in the upright position, and, in women, from childbearing. Its onset is no less gradual than its progression is certain. The surface veins are large, prominent, tortuous, and in advanced cases sacculated and calcified. In the presence of such veins the onset of ulcer is gradual. In many instances pigmented areas about the veins offer evidence of the prolonged irritation of the skin. These areas, generally covering a distended portion of the vein, "riding" it, as it is said, may persist for long periods and even extend considerably without otherwise changing in character. Sooner or later, however, trauma or the actual rupture of the vein precipitates a painful, inflamed ulcer. Once established and neglected, it spreads, to become finally a large discharging area of "unhealthy" granulations surrounded by a zone of inflammatory tissue. The skin about it is pigmented and the parent vein, or veins, can be seen entering the pigmented zone from above. In legs extensively scarred from long-standing and repeated ulceration, it is not uncommon to see the sudden recurrence of widespread ulcers accompanied by evidence of cellulitis. Such are the ulcers of surface varix. They are insidious in onset, are confined for many years to the vicinity of the principal vein or veins of the calf and are said to "ride" them. Neglected, they tend to spread, increasing induration and scar tissue marking their advance, until in the late stages, large areas of the calf may be covered with avascular scars of low resistance.

Ulcers of surface varix (non-inflammatory type) complicated by varicosity of the perforating veins. When in the presence of varicose veins of the usual mechanical origin, incompetence of the perforating veins develops, the overflow or safety vent into the deep veins is taken away and nutritional disturbances tend to become more profound. One may expect, therefore, to find ulcers not only riding upon the large veins in the usual way, but tending to appear in the region of the perforating veins. It is seldom, indeed, that in very advanced cases of varix there is not some incompetence of the perforating vessels. The ulcers found under these conditions differ in no essential particular from those of pure varix except that they may bear less local relation to the varicose surface veins.

Ulcers of surface (post-phlebitic type) complicated by varicosity of the perforating veins. The ulcers which follow phlebitis differ very decidedly from all others. The effect of the phlebitis following childbirth, fevers, and intra-abdominal operations is suddenly to destroy the valves of the veins (nearly always the internal saphenous and its tributaries) in which the inflammation occurs. The lumen is restored, but the usefulness of the vein is lost. It remains usually a hard, straight, invisible, but palpable cord, through which back pressure from above is maintained as readily as in the case of the typical varicose vessel. If the inflammation has penetrated into its finer ramefication, the changes in the leg may be considerable—the fat extensively indurated and the deep fascia thickened and scarred. But whether because of the sudden strain upon them of caring for the sur-

face circulation during the period that the main internal saphenous trunk is closed, or because they themselves are directly involved, the perforating veins very generally dilate and allow the blood of the deep veins to leak toward the surface, increasing the confusion in the surface system. Moreover, it seems quite likely that, as a result of the inflammatory reaction, the lymphatic circulation is at least locally crippled. The ulcers which occur, often within a few weeks or months after the patient is on his feet, are particularly malignant. They are often multiple, they have no relation to any visible veins (no varicose veins are visible in any case) and little or no tendency to heal even upon rest in bed. There is evidently an interplay between infection and venous stasis somewhat different from that of the more common type of ulcer, and there is evidence that infection may persist in the leg for months or years entirely apart from the ulcer as well as in its immediate vicinity, for in excising the veins originally the seat of phlebitis, one is disagreeably conscious of stirring up an old infection and leaving areas of reddened oedematous skin for considerable distances about wounds which may have healed by first intention.

The essential characteristics of the ulcer of post-phlebitic varix are the following: It always occurs (if at all) within two years and generally within six months of the phlebitis; its origin is betrayed by the history, and by the presence of hard, small, straight, and generally invisible veins in the calf and thigh; it soon develops a firmly indurated base and is surrounded by a zone of thickened and irritated skin; there will often be found in other parts of the leg in which it is situated, areas of oedema and induration as residual evidence of a very general infection of the subcutaneous tissues; it shows little or no tendency to heal under palliative treatment."

Darier (3) states: "Ulcer of the leg is observed especially between the ages of 35 and 65 years, slightly oftener in the male sex, in fatiguing occupations which require the erect positions; in women who have had numerous pregnancies and the poorer classes. The patients are, as a rule, atheromatous; sometimes polysclerotic, especially with renal sclerosis."

Among the innumerable microorganisms of all kinds which flourish on these ulcers, the principal pathogenic agent seems to be most commonly the streptococcus. Leg ulcer has been described as a "chronic streptococcic chancre," by Sabouraud.

This local streptococcia is indefinitely prolonged, sometimes latent during long periods of time; not infrequently, the presence of the bacillus pyocyaneous is likewise demonstrable.

It has long been noted that leg ulcers of typical appearance in admittedly syphilitic individuals as well as in cases of undetected syphilis, will heal under mercurial medication. More recently objectively similar cases have been recognized as tuberculous, through experimental inocculation. It is not known, however, to what extent these specific infections are involved.

DIAGNOSIS

It is important to differentiate between the ulcer of the varix type, simple ecthyma which is distinguished by the multiplicity of its lesions and the acute inflammatory character. The ulcerative syphilides and gummas which are usually multiple and bilateral and, usually, situated in the external aspect of the thighs and are grouped in arcs of circles.

Tuberculous ulcers follow bony lesions of tuberculous gummas.

Goodman (4) makes a point of the localization of ulcers on the legs as an important point in diagnosis, concluding that in the left leg diseases of retarded circulation should be considered, while in the right leg syphilitic infection should be considered.

TREATMENT

A perusal of the various methods of treatment of chronic ulcers shows such a variety, that one is forced to the conclusion that no truly successful method has, as yet, been advanced. New methods are continually coming to the foreground, only to be relegated to oblivion and yet without experimentation and correlation of facts nothing can be accomplished.

The pathology of a chronic ulcer and an infected wound of long standing is very similar; the base is covered with exudate, the edges are elevated and covered with dead epithelium, the surrounding skin is thickened and there is a small cell infiltration surrounding the entire wound.

An important principle in the management of chronic ulcerating surfaces is the stimulation of granulation and of the epithelial forming powers of their borders. This is accomplished by the removal of inhibitory factors such as sepsis, defective circulation and inefficient general nutrition. For the production of these results numerous substances have been advocated and I will review some of the later day methods.

REVIEW OF METHODS OF TREATING LEG ULCERS

Hugo Hecht (5) advises the removal of the calloused circumference surgically, then the application of iodoform and dermol and later the application of epithelial stimulation as scarlet red, nitrate of silver, etc.

Faure-Beaubien and David (6) stated that ten of their patients with leg ulcers presented a definite hyperglycemia. While no sugar was detected in the urine, they were nevertheless treated with insulin; ten units being given subcutaneously twice daily. One case got 1,600 units, but the usual amount given was 500 units. Healing took place rapidly, although these cases stubbornly resisted other treatment.

L. Ambard, F. Schmidt and G. Levy (7) also presented patients with hyperglycemia, but no glycosuria and, in addition, added one case with normal findings and a leg ulcer. In all of these cases insulin was given with, apparently, good results and they raise the question whether insulin may not stimulate healing by modifying the nutrition in the tissues.

G. A. M. Van Gaalen (8) applied a hot air box to a leg ulcer of three years' standing, three to six hours a day, at 39 degrees centigrade. He obtained healing in twelve weeks.

If we are to determine upon a rational method of treatment of ulcers and infected wounds, we must endeavor to stimulate the normal defensive power of the blood, for in the blood are found the real defensive agents of the tissues, in the shape of phagocytes and alexins, which destroy bacteria and neutralize their poisons. Upon this theory rests the justification of the modern treatment of suppurative conditions by means of heat, passive hyperemia, etc., all of which, apparently, merely aid the natural functions of the body.

There is no question in my mind but that all agencies advanced in recent years to aid the body restore an ulcerated, or infected part to normal, the ultra violet ray stands pre-eminent in ease of application, lack of pain, freedom from danger and in results obtained. Sidney Russ of Middlesex Hospital, London, says: "If a powerful source of ultra violet radiation be directed upon an infected wound, the result of an adequate exposure will be that the pathogenic organisms on the surface will be directly killed. Cultural plates made show that bacterial cultures of all types, including the spores of tetanus bacillus, upon radiation by ultra violet light between 2,960 and 2,100 Angstrom units, were all promptly killed."

McCaskey, D.: (9) "Ultra violet light acts as irritant to the skin. Vitality, therefore, of numerous cells is decidedly damaged and in order to take care of this damage there is a dilation of the blood vessels as a means of removing the dead and damaged cells. In other words, resorption takes place. There is also a sedative

action upon the cutaneous nerves, tending to reduce nerve irritation, thus rendering the most painful ulcer practically painless in a comparatively short time.

Laboratory investigation has determined that radiation with the Kromayer lamp of from three to five minutes at approximately four inches is powerfully germicidal and bacterial cultures of all kinds which were radiated by this type of ultra violet light were promptly killed, thus establishing the intense bactericidal action of the ray."

The air-cooled lamps emit the longer light waves, between 4,000 and 3,000 Angstrom units. These are more penetrating than the short rays. They are chemically oxidizing and stimulating to metabolism, while the shorter waves are more bactercidal. The air-cooled lamp is a builder. The effects are peripheral stimulation through nervous reflexes, increasing the circulation of the blood; increasing nutrition; and increasing local metabolism and phagocytosis. The results are due to increased elimination, relief from toxic conditions, increase in haemoglobin, and stimulation of the skin and its glands. It also has an unquestionable effect on the endocrine glands, and there is an increase in the ionic calcium and inorganic phosphorous content of the blood serum.

Based upon these factors, the treatment of ulcers by ultra violet ray is logical and scientific.

METHOD

The method that I have used with the greatest amount of success is as follows: The ulcer is cleansed the day before by using a moist boric acid, or Dakin's solution. The edges of the wound are denuded of epithelium by brushing with gauze and curetting with a dermal curet. Mercurochrome has been found to carry the ray further into the tissue, so the wound is then painted with a 2 to 5 per cent solution of mercurochrome. The Kromayer lamp, using either pressure, or a one-inch distance and from three to five minutes in time, is then used. At the same time the body, generally, is exposed to a therapeutic dose of air-cooled ultra violet ray. Sterilization of the lesions and stimulation of granulation of tissue takes place, followed in a short time by regeneration of a smooth epithelium. A general rule that is good to remember is, that satisfactory results can be obtained by using an amount of ultra violet ray that will cause inflammatory changes in the normal skin.

It is not sufficient to use only ultra violet ray, because if we do this we forget some of the underlying causes. The leg should be dressed with gauze and tightly bandaged. After the ulcers have healed care should be taken to prevent recurrences. The wearing of silk elastic stockings, and excision of the vein, where inefficiency of the venous circulation of the part has been demonstrated, is valuable. This operation should never be performed before the ulcer has healed, as the wound might become infected from the ulcer.

SUMMARY

(1) Leg ulcer is a disagreeable and disabling condition.

(2) A study of the etiology reveals the following; That ulceration is caused by—

(a) Syphilis.

(b) Trauma.

(c) Sepsis.

(d) Phlegmasia albadolens.

(e) Varicosity.

(3) That trauma and infection are a valid influence in the poor.

(4) That the ulcers depend upon the character of the varicose veins and as such are divided into—

(a) Ulcers of the surface varix.

(b) Ulcers of the surface varix complicated by varicosity of the perforating veins.

(c) Ulcers of the surface varix of the post-phlebitic type.

(5) It is necessary to differentiate between ulcer of the varix type, simple ecthyma, ulcerative syphilides, and tuberculous ulcers.

(6) A perusal of the methods of treatment shows such a variety that one is forced to the conclusion that no truly successful method has as yet been advanced.

(7) The most important principal in the management of chronic ulcerating surfaces is the stimulation of granulation and epithelial forming powers of their borders.

(8) This may be accomplished by the removal of inhibitory factors such as sepsis, defective circulation and inefficient general nutrition.

(9) (a) Ultra violet ray has been found to directly kill pathogenic organisms on the surface of the ulcer.

(b) It stimulates the normal defensive power of the blood.

(c) It aids in the production of resorption and has a sedative action upon the cutaneous nerves.

(d) The efftcts of the air-cooled lamp are peripheral stimulation; increased circulation of the blood; increased nutrition; increased local metabolism; and phagocytosis.

(10) Applying these physiological facts to the treatment of ulcer, we have a method that adds materially to the comfort of the patient and the speed of the recovery. Combined with attention to prevent recurrences, it it probably the best method that has been offered.

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DISCUSSION

Dr. Lynne B. Greene (Kansas City, Mo.): It is an unfortunate thing that the leg has a dependent circulation, and the circulation has probably a great deal to do with the condition.

The essayist described a number of venous anomalies and also the trauma that was found. He also described some of the constitutional disturbances that had to do with ulcers, but some of these things depended upon the fact that the leg is the lowest part of the body. I would suggest, therefore, in the matter of treatment that elevation be used.

His description of the various means that we already had before the advent of ultra violet is good. I know of nothing better. The technic of the use of ultra violet was excellent.

I think I emphasized yesterday the fact that the skin is an organ. I think that a great deal of the trouble that a patient experiences, who has an extensive leg ulcer, is due to the fact that there is a certain percentage of the skin that is not functioning. This may not be just limited to the margins of the ulcer, but extends beyond, or other portions of the skin of the legs are about to break. This fact must be remembered: that the larger percentage of the skin is not functioning as is evident by the margins of the ulcer.

Of course we all know that ultra violet does not affect the syphilitic ulcer. It is a question of diagnosis largely in leg ulcers. I have seen men treating syphilitic ulcers with ultra violet, not knowing they were syphilitic. The ulcers in my experience that have responded most of all else to the use of ultra violet have been those from trauma and varicosity. Phlebitis is rather discouraging because we have repetitions of the same things that are purely physiologic and we have recurrences in these patients from practically the same source about the time we get them healed up from a previous attack.

I have found that diathermy used about the edges of these ulcers has proven of great benefit. Keep your leg warm; keep it elevated, in addition to the use of ultra violet. I cannot improve upon the technic as given by Dr. Schiller.

Dr. J. U. Giesy (Salt Lake City, Utah): The ultra violet works; there is no question about that. Let's not, however, forget that we are physicians. First, we must find out what kind of an ulcer we have. Then we must find out what our patient's general condition is. I want to call the attention of the body here this morning to this fact: In my experience at least I have found that frequently in connection with the ultra violet the use of a little parathyroid and lactate of lime is an excellent thing. Frequently in ulcerations not only of the leg, but elsewhere, we find a disturbed lime metabolism, and in a great many of these cases you will speed up your end result very much by that technic.

These ulcers heal up frequently unless great care is exercised by the patient and a great deal of patience by the doctor in encouraging that patient, they break down again. The idea is to not only heal it but to make that healing sufficiently strong and resistant to bear up under the wear and tear of use. After your wound is healed, take a copper plate large enough to cover the wound and a considerable area around it. In all of these cases an infection of the venous tract means a low grade phlebitis whether it is sufficient to produce thrombosis or not. You have an infected zone around it. The ultra violet may have sterilized it and in a great many cases I suppose it does. It may not entirely, however, have obliterated all the infection. Take this copper plate and apply it to the limb and hook it up to a positive galvanism, making your active pole the positive pole, put your large galvanic pad elsewhere, and subject that skin to a positive galvanism for ten or fifteen minutes with such amperage as the patient can stand. If you remember the action of the positive it is to dilated vessels more or less of stimulant; it is hardening.

Dr. O. M. Moore (York, Nebr.): Possibly I got into this discussion after you shut the gate, so I am going to put it as an adjunct to recent physical measures; I really think it shouldn't be passed over in silence because it has to do with success. Some of us older fellows hark back to other years. Perhaps you have read Flint's old work on medicine; there are about 150 pages of etiology and history and about five words on treatment. The etiology and diagnosis in this paper were splendid, but there are other things that we must not entirely discard even if the newer treatment is efficatious and a splendid adjunct to the older treatment, and I just want to mention one factor here. I have treated leg ulcers for a great many years. I never have seen epithelium grow over and cover an old leg ulcer when the borders were not down even with the granulations, and the best way to get that is pressure. I have had patients come to me with a bag full of ointments, blue, green, yellow, and other colors, of all consistencies and full of all kinds of medica, and I have tossed them all aside and used nothing of that sort excepting perhaps a green soap poultice for a few hours to cleanse it out and then put on your pressure, first a pad of gauze and a ZO plaster and bandage that leg from the toes to above where the varix was, and after you get the borders down even it will soon be covered with epithelium.

With the added armamentarium of ultra violet light and diathermy you have got a successful treatment for nine-tenths of your leg ulcers.

Dr. Morris Reingold (Lynn, Mass.): I should like to ask Dr. Schiller how often he uses the treatment and whether he increases the exposure every time he gives the treatment, how much he increases it, and does he use a dry dressing afterwards.

Dr. E. G. Waddington (Detroit, Mich.): I just wanted to add a point regarding technic to Dr. Schiller's most illuminating and practical paper. Here is a point to get over: Dr. Schiller in his limited time did not go into all details.

In using ultra violet (I am talking about quartz lamps now) don't forget that the lower rays are destructive to granulations. If you have sepsis in your wound you will naturally do as Dr. Schiller told you, get your lamp down closely so as to kill the infection. Now you want to bring blood to that part, so don't use your water cooled lamp close to it. I would not use the water cooled lamp in these cases unless I had it far away. I would use the air cooled for my metabolic condition. I want to raise metabolism of this part. Therefore, use the air cooled lamp at about 20 inches. The dose would simply depend upon the rays of your lamp; keep the dose below the erythema dose. Do not bring on an excessive reaction because you are apt to kill the granulation. Have it about 20 inches away so as to stimulate the granulation. If you use a water-cooled lamp after you have got your granulation started, you are going to overcome that.

I remember giving a little talk at one of the hospitals in Denver. The technician had an ulcer and she had been using a water-cooled lamp for two or three months. The ulcer kept breaking down all the time. I said: "You are breaking it down with your lamp. Get the air-cooled about 20 inches away and you will heal that up."

Sure enough, in a short while it was healed up.

Pick out your remedy and use it correctly.

Dr. Schiller is perfectly correct in what he told you, but, as I say, he did not have time to go into all the details, and he will corroborate what I said, that the water-cooled lamp will break down granulation. You must use the air-cooled to build up those wounds.

DR. L. V. DAWSON (Amarillo, Texas): I don't think any man should ever treat one of these ulcers as has been brought out, unless first a Wassermann and a sugar test of the blood is taken, because you are going to go wrong if you depend on your lamp in cases of phlebitis. The majority of these cases can't go to bed, and I don't believe that any of them have to be put to bed.

DR. SCHILLER (closing): I said when I started this paper that I would probably know more before I got through than I knew when I started, and that is just about what has happened.

Keeping the leg elevated, as suggested by Dr. Greene, answers one of the other questions. Most of the people who have leg ulcers are poor and when you put them to bed, you injure their social status; you injure their family, and if you can possibly avoid putting them to bed, it is better; if you can keep the patient working, he has a lot of mental comfort that he wouldn't otherwise have. It is true if you put him to bed the ulcer may get well faster, but you are doing something to the patient that he may not be able to bear. You may take a patient that has self-respect and you may make a charity patient out of him.

In going over the treatment of leg ulcers, I didn't think it was necessary to mention all of them. I mentioned some of the later-day methods and had to be content with that.

In the use of parathyroid and lime, we did quite an extended series of calcium determinations in leg ulcers and the normal calcium in our determinations were between nine and eleven, so we felt that we were not getting very far in calcium therapy. It is possible that a patient may have a calcium coefficient of nine or eleven and still be deficient in calcium, but we didn't feel that it paid to work further along those lines because some of them that we gave parathyroid and calcium to, got better, and some didn't, and since there are so many other methods that do the same thing, we didn't attribute very much significance to this.

I was very glad to know about this method of galvanism. I am going to try it.

Dr. Reingold asked about how often the treatments were given and the kind of dressing. We usually try to get the patients every other day. We usually treat the patient whenever he is able to come in. Sometimes they come in when they feel like it and you have got to regulate your treatment according to the convenience of the patients, as a rule. We usually dress these ulcers dry unless they show a lot of bleeding, and then we use a moist boric dressing for the time being.

Dr. Waddington made a statement in reference to the use of the Kromayer lamp. A great many ulcers we found would not clear up with the Alpine lamp at a 20-inch distance alone. When you have a badly infected ulcer, and most ulcers are badly infected before you see them, unless you kill the infection you are not going to get the results that you should get. You can stimulate the defensive power of the tissue and sometimes get away with it, but unless you plan on getting rid of your bacteria, scraping the edges of the ulcers, they do pile up; scrape them down, brush them down with a piece of gauze; you won't get the results that you ought to get.

I have never used the carbon arc lamp, but we have one at our hospital and we are going to switch over and try a series of them, using both the lamps, and see whether we can duplicate Dr. Goodman's results.

I want to impress one thing upon you. Ultra violet ray and diathermy and galvanism and all physical therapeutics are nothing but an aid to the practice of medicine, and if we lose sight of that fact we will be wandering in a wilderness of therapeutics.

As one of the doctors mentioned, we are physicians; the patient must be made well, and in order to get the patient well, we first must make a diagnosis, and after our diagnosis is made, we must use all measures at our command to get the patient well. I think if we do this we will not only be better physical therapists, but better physicians.

THE ROLE OF LOCAL AND REGIONAL ANAESTHESIA IN SURGICAL DIATHERMY*

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The employment of surgical diathermy especially in the treatment of malignant tumors, has among other things, the great advantage of a very low primary mortality. To employ general anaesthesia, with all its dangers to the patient, would mean an impairment of this superiority over the cutting operations. Even if its efficiency in general surgery should be questioned, no one can doubt for a minute that we have a direct indication for the use of local or regional anaesthesia in surgical diathermy. This is not only because of the tremendous advantage over general narcosis as far as the after-effects, both present and remote, are concerned, but from a technical standpoint it is far more satisfactory and far more safe. The danger of the inflammatory action of ether or the explosive effect of ethyline gas renders both of these anaesthetics absolutely unsafe when diathermy is employed. Nitrous oxide gas as a rule furnishes insensibility of a short duration only, which makes it especially undesirable in operations within or about the oral cavity. Even when nitrous oxide gas is used in the coagulation of tumors in other localities, the patient awakens as soon as the mask is removed and his pain begins immediately, while under local anaesthesia the wound remains at least partially anaesthetized for as long as twenty-four hours and the old "wundschnerz" of the German authors is entirely lacking in the majority of instances.

It is not the purpose of this paper to discuss the history of local anaesthesia and the separate technique of its multiple applications. That is obviously of much greater scope than time or space will allow here. It is rather to stress the advantage of this method when surgical diathermy is employed, to go somewhat into the technical details of its use and to differentiate between the purely local or infiltrative method and the regional or nerve-blocking type. Due to the efforts of Braun, Kappis, Illyes, Labet, Narath, Denk and others in Europe, and Kolischer, Lowsley, Pugh, Farr, Harris and others in this country, local anaesthesia has been so perfected that it can be used with absolute safety and almost 100 per cent efficiency in operations on almost any part of the body. This is not to say that it is not without danger in the hands of the novice or that perfect anaesthesia will be obtained in every instance without a reasonable amount of care on the part of the anesthetist.

Neither do we wish to convey the impression that the technique is especially difficult. Local anaesthesia, like every other technical proceedure, is not mastered without a certain amount of study and care and if the operator will put in as much time learning this technique as he does learning the technique of the operation, he will soon have it perfected.

Whenever it is possible, it is always preferable to use regional or nerve-block anaesthesia at a point distant to the operative field. However, there are some instances when simple infiltration around the tumor area will give a perfectly satisfactory result. Then too, there are some types of regional anaesthesia which entail an intimate knowledge of the nervous anatomy of the part besides offering some technical difficulty and this is obviated when simple infiltration can be satisfactorily employed. On the other hand, there are certain types of regional anaesthesia such as sacral and sacro-lumbar anaesthesia which are especially easy of application and perfectly satisfactory in their results.

*Read at fifth annual meeting American College of Physical Therapy, Chicago, Oct. 21, 1926.

By adding to the quantity of solution, prolonging the time of injection and lowering the head and shoulders of the patient, we have extended the ordinary sacral anaesthesia so that we have been able to include not only the pelvis, but the entire lower extremity in our operative field. The flooding of the epidural space can be made to include not only the sacral trunks, but the lumbar trunks as well, and the feasibility of this method has been demonstrated by at least six amputations and several other minor and major operations on the lower extremity to be reported in due time. Jonesco has reported remarkable success with the use of spinal anaesthesia, but this method has not been without danger in this country and elsewhere, while the mortality of sacral anaesthesia is absolutely nil.

In the treatment of bladder and prostatic tumors by surgical diathermy, we have an ideal indication for the use of sacral anaesthesia. The baneful effects of general anaesthesia are particularly well emphasized in those suffering from this condition. Here we usually have a kidney involvement, the blood urea is comparatively high and the renal function is at a low ebb. The cardio-vascular syndrome as manifested by hypertension, myocarditis, emphysema and arterio-sclerosis is usually associated and these patients simply cannot stand a general anaesthesia. These are usually the cases where under general anaesthesia "the operation is a success but the patient dies." By sacral anaesthesia is meant the blocking of the sacral plexus by the introduction of an anaesthetizing agent into the epidural space through the sacral hiatus. The drug of choice is novocain, although tutocain, neocain and other drugs (except cocain) have been used with success. Twenty-five cubic centimeters of a 1 per cent solution of novocain (freshly prepared) which contains one-quarter of a milligram of suprarenin is amply sufficient. We have found suprarenin of indispensable value. It not only enables one to hold the quantity of injected novocain to an absolutely safe amount, but it delays the absorptive time to such an extent that it is possible to work as long as three hours if necessary. Beyond a slight rise of the pulse rate, which subsides soon after operation, we have never been able to confirm in the use of suprarenin, the toxic effects of adrenalin as reported by Pugh, Lowsley and E. Mayer. Perhaps it is because suprarenin is a synthetic product and the purity of its manufacture can be more accurately controlled than adrenalin.

The technique of sacral anaesthesia is simple if a few salient points are kept in mind. The patient is placed on the side with the hips and knees flexed at right angles. After the routine sterilization of the skin is carried out, the cornua of the sacrum are located by palpation. In the center of an imaginary line running between the cornua an intradermal injection of the solution is made with a fine needle. Through this small wheal an 18-gauge needle, 12 centimeters long is inserted first in a vertical direction until it strikes the bone and then in an oblique direction through the ligament which stretches across the cornua. When the tip of the needle strikes the upper bony periphery of the sacral canal, it is slightly withdrawn and we are ready for the injection. Before the syringe carrying the solution is attached, we must make sure that the dural sac has not been punctured as evidenced by the escape of clear or even bloody fluid from the distal end of the needle. If such be the case, which very rarely occurs, the needle is entirely withdrawn and reinserted. The solution must be injected very slowly, at least two minutes being consumed in this act. The author in conjunction with Drs. G. Kolischer and C. G. Schnetzer reported in July, 1924, eighteen hundred administrations of sacral anaesthesia with only a few failures, all due to technical shortcomings. Since that time we have improved our technique so that our failures are practically nil. We can heartily recommend it in all pelvic operations of whatever nature and with the lumbo-sacral anaesthesia as described above for all operations on the lower extremity, especially where surgical diathermy is employed.

When it is intended to use local infiltration to block off a malignant tumor for the subsequent use of surgical diathermy, care must be taken that the needle point must not penetrate the tumor but is carried wide of the area. Then there will be no chance of carrying the infective material into the system. The same solution is used for local infiltration as for nerve-block, the percentage of novocain and suprarenin remains the same and the quantity of solution is gauged by the extent of the morbid process.

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DISCUSSION

QUESTION: I wanted to ask the Doctor if he found it necessary to inject the sacral foramina at the same time.

DR. L. V. DAWSON (Amarillo, Texas): I should like to ask the essayist if he ever has to exceed 25 c.c. of the solution in order to secure complete pelvic block. Furthermore, in doing low pelvic operations through abdominal incisions, how far up does this anesthesia extend? How far is it necessary to bring down your infiltration in the abdominal wall?

DR. FLOYD W. WILLIS (Chicago, Ill.): I should like to ask the essayist to please give me the technic for giving the anesthesia in epithelioma of the lower lip. What local anesthesia would you use in doing coagulation?

DR. J. U. GIESY (Salt Lake City, Utah): I will bat for Keyting since he is from my town.

Your spinal anesthesia, of course, is largely a hospital procedure and is of particular value in pelvic conditions, but there is a lot of this stuff that can be done by the physcian outside of the hospital by infiltration, and it might be of interest to stress that point just briefly.

The doctor brought out very conclusively the fact that if you are going to do any local work you want to keep well away from your neoplasm. In my own experience in doing this work on malignancies, I simply enclose that neoplasm as far as possible in a square. I make four punctures. I infiltrate in this line so as to include the neoplasm well within a square. I have then, the whole area under infiltration anesthesia. You can then go into this tissue and do work in a zone around the neoplasm, and build up a line of defense against lymphatic and circulatory absorption and then destroy the neoplasm.

I merely bring that out because it applies to the work done outside of the hospital, and I think that it graphically illustrates a method of doing that by general infiltration in a wide zone around the neoplasm.

DR. EDWIN N. KIME (Indianapolis, Ind.): I should like to ask a question or two merely to determine definitely what the essayist's viewpoint is with regard to general anesthesia. If I understood him correctly, he stated that general anesthesia was absolutely contraindicated when surgical diathermy is used. That may not have been just exactly what he said, but that is the way I understood it.

There have been, in my experience, a number of conditions in which I have used surgical diathermy, in which it would have been difficult to have handled the case wthout using general anesthesia. I have in mind a reference to the extirpation of the nose and the neoplastic metastases into the antrum. A regional anesthesia here would have been a matter of considerable technical scope, and there are other instances in which it has been quite convenient for me to use nitrous oxide anesthesia in patients for minor procedures at the office. I have removed a venous angioma from the scalp of a child four months of age under ether anesthesia alone.

Of course, one must remember the explosive properties of ether vapor, and one should, after the patient is anesthetized, remove the vapor, the ether, entirely from the room. I have seen no ill effects from a number of instances in which ether was used in that very careful manner, also a number of instances in which nitrous oxide was used.

I heartily endorse everything that he has said about the use of local and regional anesthesa, but I wonder if it is necessary for us to entirely remove general anesthesia from our anesthetic armamentarium.

Dr. C. H. Wolner (Montevideo, Minn.): It seems to me general anesthesia could be used easily enough if the patient was screened off in such a way that you could use a fan to draw away the vapor of the ether from the room.

Dr. Henry Schmitz (Chicago, Ill.): Speaking about ether anesthesia particularly, when you wish to operate on the upper part of the abdomen, I wish to just cite to you two instances that I have seen personally of very violent explosions which caused the death of the patient. In the one instance an apparatus was used, one of the smaller apparatus in which the ether was heated by an electric current. It appeared that a short circuit took place. The ether exploded and practically tore the patient's insides to pieces. The patient died in a few hours afterwards.

Another instance I have seen is where a cauterization was to occur in the mouth for carcinoma. Ether was given. When the patient was thoroughly anesthetized, the ether was removed and a cold, wet towel applied. Still the explosion occurred and the patient died on the table.

There isn't anything that I know of that will tell us whether such an accident is going to occur Therefore, I believe that when we use diathermy or any kind of cautery in the air passages we should not proceed by the use of ether or ethelyne that will explode.

The use of spinal anesthesia in our work has proven of very great benefit, particularly in those cases where general anesthesia is entirely contraindicated; in other words, where the patient could not possibly have been subjected to an operation unless we had some other means. We use infiltration anesthesia wherever we can. In carcinoma of the breast it is very rarely we do a radical operation without using infiltration anesthesia, but in the pelvis we use spinal anesthesa. So far we have not seen a single accident of spinal anesthesias that we have given, and they extend over the last ten years.

We have a still simpler method than Dr. Jones described, and that is this: We take the tablet which contains adrenalin or suprarenin as it comes from the manufacturer and place it in a small medicine glass and as soon as the spinal canal has been punctured, we dissolve the tablet in the spinal fluid. The object is this: In the first place we do not materially change the specific gravity of the solution which is injected in the spinal column, and secondly, we do not add to the spinal fluid 25 c.c. of another fluid unless we would waste 25 c.c. of the spinal fluid before we inject the 25 c.c. of the solution.

These are the few points which I wished to bring uot.

Chairman Willmoth: Dr. Jones, will you close the discussion?

Dr. Arthur E. Jones (Chicago): I wish to thank the gentlemen for their lively discussion. First of all I want to say that while I may be an enthusiast on local or nerve block, regional anesthesia, I don't believe it should be used to the exclusion entirely of general anesthesia. There are instances where we cannot use local anesthesia. However, I think I brought it out fairly well in the paper that in using ether or ethelyne, especially where electricity is used, there are dangers, and besides, the usual dangers of ether or general anesthesia to the patient afterwards, so that if we can use local anesthesia it is better to use it.

The next point I want to bring out is that sacral anesthesia is not spinal anesthesia. Don't get those two terms mixed up. One is outside of the spinal canal, outside of the duramater. It is epidural and has nothing to do with spinal anesthesia. It is a nerve block anesthesia just the same as if you block the nerve at the end of the big toe, only they are blocked closer to their points of origin.

In regard to the question about carcinoma of the lip, simple infiltrative anesthesia we have found to be the best around the tumor mass. We have used the nerve block anesthesia the same as is used for goiter or any of the neck operations, but somehow or other we seem to miss a few of the nerve filaments and we have found that the simplest and best method is simple infiltration around the tumor.

I described novocain in my paper. In regard to using more than 25 c.c. of a 1 per cent solution, we have very rarely found it necessary in simple sacral anesthesia. Sacral anesthesia is divided into ordinary sacral anesthesia, simple anesthesia and deep sacral anesthesia. For deep we have added to the amount of solution; we use simple sacral anesthesia for operation

on any of the organs of the pelvis, but in case we want to go up further and get the lumbar trunks, then we use more, but we wait a little while, tip the patient up, drop the head, and then give 25 c.c. more.

We have never yet found it necessary to do the so-called parasacral anesthesia or inject the sacral nerves on the side of the sacral canal. We can't understand how, if you get into the sacral canal, it is necessary to inject these nerves, too. We have had some failures; perhaps that is the reason, but from an anatomical standpoint, we can't ascribe it to that reason.

In regard to the local anesthesia for coagulaton of tonsils, while I have not done any tonsil work, I have seen some of this done and the technic seems to be the same, using the 1 per cent solution of novocain with the adrenalin, and then, as Dr. Schmitz says, you can get these tablets all made up. You know adrenalin is a very potent drug and you can't measure adrenalin by drops. Any hospital that measures adrenalin by drops is behind the times, because one drop may be eight times as large as another drop. You have to have that weighed and the best way is to get these tablets. I think Metz puts them out. They put out these tablets in different sizes, an eighth of a gram, a twelfth of a gram, and so forth, and it is very easy to add so many tablets to a hundred c.c. of solution to make up a hundred per cent solution. The solution should be freshly prepared.

In regard to the technic of the tonsil, I think the infiltration of the pillars as used by most tonsil men for the extirpation is the same method as used for the coagulation, as far as I know.

PRINCIPLES OF SURGICAL DIATHERMY TECHNIC*

GUSTAV KOLISCHER, M. D.,
Chicago

If you will permit me to recall to your minds a few fundamental items so we can meet on a common ground of understanding, I will do so. Our present conception of electricity and all its phenomena is this: We believe now that what we call electricity is rather a mysterious power, a force inherent in the smallest particles of matter and we call these smaller particles electrons. It is our conception that each atom consists of a nucleus—one electron which is charged with positive electricity. Surrounding it and revolving around the central electron are any number of electrons that are charged with negative electricity. It is obvious if the sum of all negative electricity and the positive electricity inherent in the central electron are of the same amount, this atom will be electrically neutral. It is also self-evident that if by some impulse some of the negative electrons are carried off, the positive electricity will outweigh the negative electricity. If by some influence the molecules are split up in groups of atoms, which respectively carry only the positive or negative electricity, then we talk about ionization. Ions are groups of atoms that carry only one kind of electricity. If by any secondary impulse ions or electrons of the same charge are stampeded in one direction, then we talk about an electric current. That demonstrates at the same time that to talk about a monopolar current is self-contradictory. The intrinsic conception of a current is the transportation of electricity from one pole to another.

We distinguish three kinds of current. If a current always travels in the same direction, then we talk about the direct current. If this current is not interrupted at all, if there is a steady flow in one direction, then we speak about a galvanic current. If this current is interrupted at regular intervals, then we talk about a faradic current or faradization of the current. If a current changes its direction at regular intervals, reverses itself, then we talk about an alternating current.

As a matter of convenience we talk about high frequency current. If these reversions in a unit of time reach in the thousands, then we talk about high frequency current. It is only the number of reversals in one second that is denominated by the name high frequency current. In order to measure the whole amount of electricity that is carried by this current in another locality, we are agreed on certain measurements, voltage and amperage. The principle is this, and it is very easily explained: Suppose that we have here a vessel; this vessel has an outlet that leads into another lower vessel. If we fill this upper vessel with water, by the law of gravity, the water will percolate from the upper vessel to the lower vessel. This gravitation, this back pressure is represented and measured by what we call voltage, the electro-motive power. The quantity of this water that is going to flow into this lower vessel depends also on the caliber or width of the outlet of this hose that connects the upper vessel with the lower vessel. The velocity or the intensity of the flow is what we call amperage. Therefore, if we increase voltage or amperage, we increase the volume of our current. Twice three is six, so is three times two.

Consequently, it is absolutely erroneous to maintain that in order to produce an efficient current, a current strong enough to produce the effects that we need in medicine, you have to have a high voltage. We can increase the amperage and get the same volume as if we increase in the same proportion our voltage.

*Read at fifth annual meeting American College of Physical Therapy, Chicago, Oct. 18, 1926.

Now as to the other items that are important in producing medical effects: It is a fundamental physical law that no energy can be lost. Energy can be transformed, but it cannot be destroyed. If you have a revolving wheel and put the brakes to it, the revolutions will stop, but the brakes and the wheel will get hot. It is a transformation of the motoric power into caloric power. The same holds good of the electric current.

We talk about resistance. What is resistance? The electrons that carry the electricity through a metallic conductor or the ions that carry the electricity as a current through a fluid or a semi-fluid matter like the human body have to sneak between the atoms and electrons, between the inert ions.

This friction represents what we call resistance against electric current. By transformation of part or the transformation of the entire electric energy, caloric energy is produced. We know if we run an electric current to any kind of a conductor, a certain amount of this electric potentiality will be transformed into heat. The amount of heat depends first, on the volume of current; second, on the resistance of the current against its travel through the tissues or through any kind of a conductor, and, third, the length of time during which we try to force this current through a conductor. This law holds good for a good conductor and for a poor conductor. If you take a wire and run an electric current through it a certain length of time, the wire will get hot. The thinner the wire, the quicker it will get hot and the hotter it will become, because a very thin wire offers a greater resistance to the amount of electrons that are forced through it by the electric current.

We use for medical purposes electric currents in order to produce heat under certain conditions. Why do we use high frequency currents? The reason is this: If you use a direct current, irrespective of whether it is a galvanic current or an interrupted current, and use enough current to produce appreciable heat, the patient won't be able to stand it because physiological effects will take place. The first is pain; second is irritation of the irritable structures, nerves and muscles; third, decomposition, electrolysis. That is the reason we use high frequency currents; they are free of physiologic side effects.

I would like to mention again that the production of heat has only to do with the volume of the current and the resistance of it by the tissues to this current forced through them, and, incidentally, the length of application. The reverses per se have nothing to do at all with the production of heat, whether you send the same amount or volume of current at the reversion of 50 times a second or 2,000,000 times a second has nothing to do with the production of heat. We know that if we reverse a current often enough during a unit of time, the physiological effects will not show. There is not enough time to develop that. The actions neutralize each other. The ions travel so fast in one direction and return so quickly they neutralize all these side effects. There is no irritation of the sensorial nerves, no pain; there is no irritaton of the motoric nerves, no jerking of the muscles or tendons and there is no electrolysis. That is the reason we employ high frequency currents for the production of heat within the human body.

All we know about the action of this high frequency current is the production of heat. It may be possible, or seem probable that there may be certain chemotactic changes within the cells, but we don't know anything about it. All we can put our finger on is the production of heat.

For this production of heat by high frequency currents, the term diathermy was coined by Nagelschmidt, who was practically the instigator of this whole discipline.

I would like to call attention to another confusing term. You will hear all the time that some gentleman uses a direct current. The mat-

ter of fact is that a direct current isn't used at all for diathermy. To call this current d'Arsonval current is simply a historic compliment and nothing else. It is true d'Arsonval mentioned the fact that high frequency currents may produce heat, but in his original publications he specifically stated that heat is an undesirable side effect, so he didn't use it intentionally for medical purposes. Nagelschmidt did that first.

Another reason we changed the modern apparatus for high frequency current is a practical one. In the older apparatus we used rather high voltage in order to produce the necessary volume of current. That is a very great disadvantage. If you use a high voltage, you have to insulate your patient, you have to insulate the operator, you have to insulate the assistant and you have to insulate everything around and use non-conducting retractors, providing such are needed. It is not only an inconvenience but it causes danger to the patients, because if the slightest mishap occurs, the patient will suffer from an electric shock. That is the reason the modern apparatus is built on the principle of as low a voltage as possible, just enough to furnish enough electro-motive power to start the current and for the development of the necessary amount of heat they rely on amperage.

The production of heat by high frequency currents to such an extent that it exceeds the physiological limit we call surgical diathermy. That means the tissues are necrotised, the tissues are killed. If we use high frequency currents, a certain damage may be done even with a low volume of current, as mentioned by Nagelschmidt when he cautioned against this excessive medical diathermy, because coagulation of globulins takes place. That is the reason that so often by applying excessive heat we do more damage than good.

The principle on which we use surgical diathermy for the destruction of tissues and structures is this: We take a very large metallic electrode and connect that with one outlet of our machine, and a smaller electrode with the other outlet. It is obvious that all the power lines of electric current that will emanate from this large electrode will naturally concentrate on this small electrode. That means all the volume of current will be concentrated there. That means a greater amount of current is forced through a smaller amount of tissue; that means increased resistance; that means an increased transformation of electric into caloric energy at that point.

The other way of coagulating is to use three electrodes, two active electrodes of the same size and then the power lines will run parallel and you will get the same amount of heat between the electrodes at any chosen spot. Why do we use for coagulation purposes high frequency currents and not an actual cautery? It has been very well known for centuries that heat is very beneficial in the destruction of malignant tumors. If you use a soldering iron, there is always one thing in your way. You can impart the heat to a depth of perhaps half a centimeter only, then you are through. It cools off and you have to stop and heat it again, and so on. In surgical diathermy we can produce the heat at any chosen spot within the body or on the surface of the body. It is absolutely within our power to locate our coagulation. Besides this localization we can produce any amount of heat that we feel is desired in this particular case; we have a guaranteed orderly procedure of the whole operation. That is the great technical advantage.

There is another advantage in preferring surgical diathermy over the actual cautery. That, I think, is one of the greatest items in dealing with malignant tumors. In the first place, as soon as you coagulate. you seal all the lymphatics and small arterioles in the surrounding tissue. Consequently there is no absorption of the products of dry distillation by the burn. You know the danger of a burn doesn't depend on the depth of the burn, it depends on the area of extension. If you burn one-third of the surface of the body, even so that only the cutis is

burned, the patient will die under all the symptoms of ptomain poisoning, because there is no barrier to the absorption of the products of elimination. This barrier is immedately formed by diathermy.

Second, by coagulation with a high frequency current, we form a zone around the coagulated area of highly activated tissues which has a great deal to do with guaranteeing the permanent cure in cases that are amenable at all.

As to the choosing of electrodes: In former years we, in a great many cases, used pads covered with some absorbent material, cotton or sponges. That is a rather dangerous procedure as hot steam may develop, producing enormous burns. Now we prefer to use metal electrodes, block tin or block lead. If you take the additional precaution to soap these electrodes and keep them in good contact with the surface of the body, there is not the slightest danger of any burn.

The active electrodes are of a different character. They are little pencil-shaped electrodes or needle-shaped electrodes.

As to the choice of the active electrode: If you use a needle-shaped electrode and you have to deal with a rather large tumor, it will take a very long time to coagulate the tumor, certainly a much longer time than it would take with a pencil-shaped electrode. If you use general anesthesia, it is quite a factor because every minute of general anesthesia means an additional amount of danger to the patient. Then there is another objection. If I insert a needle into a tumor in beginning to coagulate, the coagulation necessarily will produce a drying out of the tissue and an empty space around the needle. What happens then? Sparks will be produced.

Let me say something about sparks. There is an opinion prevailing that if you point the electrodes at any kind of a body, human body or metal or whatever it is, you shoot sparks into this object. That is absolutely untrue. You will draw just as many sparks out of the tissue as you shoot into it. What is a spark? A spark is the equalization of interrupted current, the equalization between two opposite electricities that are separated by non-conducting mediums, because the current has to overcome this resistance, it has to split this medium. We get the acoustic effect, the crackling of the spark and the light effect which makes the spark visible.

The spark not only burns the tissue, but it tears the tissue apart, which is always an undesirable effect. There is another point which is even more important. Even if your patient is under generl anesthesia and you coagulate by using a needle or by sliding off the electrode, producing a distance between your active electrode and object to be coagulated, you produce sparks and the patient twitches. You have not interrupted the current, you have slowed it up in reversing. What does that mean? That you have produced physiological effects you want to avoid. If you use a large volume of current, especially in using the old-fashioned machine with high voltage, this electric shock to the patient may be fatal. We saw such cases die from electric shock produced by the slowing up of reversal. The production of a shock should always be avoided.

As to when we should use one inert electrode and one active electrode or two active electrodes of the same small diameter depends on what we intend to do, and upon the location and formation of a tumor. It may be desirable to use three electrodes, two small active electrodes and one inert electrode because the coagulation takes place much quicker. The whole process is quick and more thorough and easier controlled.

Suppose we have a case of cancer of the tongue. We pull the tongue out and catch the cancer between the active electrodes and in a minute the whole tumor is coagulated. Why take a one-needle electrode and bungle around half an hour? The same holds true with any tumor that can be easily caught in the proper diameter by two electrodes. If you can't do it on account of the location of the tumor, or if

there isn't space enough, as within the rectum or bladder, then we resort to one active electrode at the point we want to attack.

As to the measuring of the coagulation, the expectancy of how far we can go and how far we should go: It is absolutely erroneous, whether you use medical diathermy or surgical diathermy, to expect to have rules laid down in exact figures. Each electrical apparatus is a unit by itself. You can not gauge the resistance offered by this body or that body. Consequently, we have to go about it in an empirical way, and the way to do it is this: You test your active electrodes empirically so you can gauge the effect. Suppose you take a piece of meat and put it on an electrode and connect it with a pole and then take one after the other of your discs and see how much penetration in coagulation corresponds with so and so many milliamperes on your amperemeter, you test your electrodes empirically. We don't burn off the tumors, we boil them down. That is the principle, slowly boiling them down.

If you have to deal with a tumor that is located in a hollow organ, that is in the neighborhood of another cavity, let's say in the bladder, you may be in danger of burning a hole into the vagina or rectum. You control that with the fingers. You will read quite often that they are putting surgical diathermy thermometers all around and you read the thermometers to find the danger line. In the first place, the heat a few inches away from your place of coagulation is an entirely different thing from the heat you are producing locally secondly, if you should over-step the danger line, by the time you read the thermometer the hole is already burned. It won't do you any good then. The fingers are very senstive and as soon as they begin to feel the heat you know you are a little bit too close and should stop. It is only common sense. There is not a scientific cloak hung around it; it is common sense and experience.

If you don't want to risk the fingers, you can do this: Suppose you want to coagulate a tumor in the bladder; put a rubber bag in the rectum and blow it up. When the heat comes near the danger line, you can smell the rubber before you do any damage. Of course, like in anything else, a certain amount of experience is necessary, but there are a few points that you can be guided by. You will know you have coagulated enough if the tumor is dry, if there are no bleeding points left, or if the tumor was a vascular tumor, you will have coagulated enough if it is black, or if it wasnt a vascular tumor, if it is white. If you have an assistant to regulate your amperage, working the sparg gap while you are working, the method is always the same as in medical diathermy; you sneak in with your current; don't start with high power. You go slowly and you can see under your disc steam bubbles come up, and the tissue, as we say, begins to sing and then you know you have enough current. Go on until the area is white or black and then you know you have coagulated it. To repeat again, if possible use three electrodes; that is the safest method, the quickest method and the most thorough method. If you can't help yourself, you have to use the single active electrode. There may be a difference of opinion. One man practices the rule he believes to be the best, naturally so. Personally, I believe that the disc electrode under all conditions is preferable to a needle-shaped electrode. The argument that you get as good results doesn't hold good. If I have a very small benign tumor, an angioma on the face, or anywhere you want it, I use very little current and a small disc. You need a very superficial coagulation to get a perfect result and you must not destroy too much tissue. If you have a large angioma on the neck or face of a baby and you go with your needle electrode and puncture it in various places, there will be numerous scars instead of one. You don't know how far you are going because the explosive force of the sparks may do much more damage than you think.

As to the use of anesthetics: If possible, like in any other surgical interference, we try now to use local anesthesia, that is the infiltration

at the base of the operation, or nerve blocking or paravertebral anesthesia. In practically every case you can get away with it. The patient won't feel a thing, provided it is done properly.

To produce a proper local anesthesia, there are two points that must not be forgotten. In the first place, don't shoot into the tumor, because you may carry into the adjacent areas. Second, the success of the anesthesia is guaranteed by the thoroughness of the flooding of all the surrounding tissue.

Suppose you have a tumor away back in the pharynx or floor of the mouth. Then you have to resort to nerve blocking, that is, flood the trunks of the nerves that supply that particular portion. Of course, it takes an expert to do it, but it can be done. The same is true of tumors on the trunk or anywhere. If you inject the roots of the nerves at their unification, after they have emanated from the vertebral canal, you get a perfect anesthesia.

As to general anesthesia, it is true enough that in the majority of cases you will get away with an inhalation ether anesthesia. If a thorough mixture of ether vapors with your atmospheric air occurs, you have a very dangerous explosive mixture. If you happen to ignite this mixture with a spark, you get a tremendous explosion. Just lately two such accidents occurred in Europe. In both instances the operator and the assistant were severely burned.

One accident, one mistake, is more instructive than 1,000 successes. The one thing that goes wrong teaches more than all the successes, because we don't know when it is going to happen. So if you can help it, keep away from a general anesthesia. An expert can give gas for a great length of time. Of course, the use of ethylene gae is absolutely excluded.

A very important development of surgical diathermy is the revival of an old method that was first devised by DeForrest, this use of a needle in producing an arc light in order to sever tissues. With certain modifications of our diathermy machine, you can produce this current without any extensive coagulation. It was proposed by some of the authors who reviewed this method and modified the instrument that that should be classified as desiccation. They claim it is an entirely different process where we sever tissues in contradistinction to coagulation. Some believe it is simply a matter of degree, a very superficial coagulation. The term desiccation I don't think is a very happy one, because when we are coagulating tumors we desiccate too. It may be much better to talk about diathermic dissection.

These surfaces are amenable to granular union by suture. That is a great advancement. For instance, if you want to remove a very vascular wart, it is a beautiful way of doing it. If you want to open a bladder in which there is a tumor, you open the bladder absolutely bloodless. At the same time there is a certain guarantee by putting this film over the edges that you won't implant any infection or any cancer cells. It is very advantageous for its protection. If you make your incision through the trigonum mucosa and enter the capsule of the prostate with the knife, there is always lots of bleeding which interferes with your seeing; if you use diathermic dissection there is no bleeding at all. Small arteries can be closed this way.

There are two points more I would like to mention. It is unfortunate, and we are all inclined this way, if we like a thing, if we believe in a method, we claim too much for it. With lots of men their enthusiasm or their imagination runs riot and they begin to believe what they preach. Conservatism will help us in this new line of work. You know for years anybody who did physical therapy had to suffer from the blight thrown on physical therapy by excessive claims. The same holds true of surgical diathermy. It has its great advantages, but excessive claims will compromise the man who practices this method. For instance, it is claimed that cancer cells are more susceptible to

heat than the normal cells. The statement was made by Doyen and was believed and one fellow told it to the next one and some people supposed to be in authoritative positions repeated it and people believed it. What is the truth Thirty five years ago Mackenrodt did what he called the igniextirpation of the uterus. The idea was this: Instead of cutting the ligaments of the parametrium around the uterus, if we sever them with the cautery or soldering iron, we are not only sure to sterilize the surfaces, and not only the sloughing that will result will carry off more tissue, but the cancer cells around the line of dissection will be killed by the heat.

A very careful investigation showed that it is absolutely untrue. The cancer cells that were in the stumps of the parametrium were just as lively and gay as before the extirpation. It was again a case of where the wish was the father of the thought.

Later on in order to accelerate the extirpation of the uterus, we used angiotribes for crushing the parametrium and other connections of the uterus. This was extremely painful to the patient afterwards. The pain didn't occur at all if we cauterized these crushed surfaces very thoroughly with a soldering iron. In every post mortem we found the same amount of cancer cells in the stumps as before, which proved that the heat does not kill those cells.

There is one disadvantage in surgical diathermy in certain parts of the body. For instance, in the mouth or on the lip, there is always a danger of secondary post-operative hemorrhage. Consequently, if we do an extensive surgical diathermy on an organ well supplied with arteries, the patient has to be kept in the hospital under observation until the sloughing is finished. This is highly important to remember.

Now a few technical points: We find quite often absolutely inoperable cases, say tumor of the tonsil or other malignant growths back in the pharynx. They can be relieved for a long time by coagulation, but in all the cases showing interference with breathing, a previous tracheotomy should be done.

In several cases of large glandular submaxillar tumors which had to be tackled in some way because the patients had difficulties in breathing and the tumors were the seat of excrutiating pains, we followed this plan with at least temporary success. In order to avoid enormous sloughing resulting when you coagulate the skin together with the tumor, we split the skin, dissected it off the glandular tumor and then coagulated only the tumor. After that was finished, we sewed together the two skin flaps and put a drainage in. In one case we had to keep the drainage in six weeks until everything drained out. This patient is still alive. What is going to become of him later on, I don't know. Technically, it was a success.

What can be accomplished technically in hopeless cases is illustrated by another case. In another case a dentist who had a very extensive cancer of the rectum with obstruction symptoms came to us. The stool he passed wasn't thicker than a goose quill. He refused a colostomy. "We will take a chance. Maybe we can burn a new channel through the tumor. We took a cone-shaped electrode and slowly bored our way through. When the sloughing was finished, there was a canal that you could put your thumb through. The constipation was relieved and this patient lived eight or nine months afterward in perfect comfort, and he thought he was going to get well. The same is true in tumors of the bladder in apparently hopeless cases; they will not be cured, but will be relieved. The same in cancers of the mouth. For instance, the tongue is first attacked by cancer, then involvement of the floor of the mouth follows. You know in these cases we can't do anything with a knife, but by coagulation we relieve the obstruction, relieve the pain, relieve the hemorrhage and if nothing else, we secure euthanasia.

DISCUSSION

DR. BROWN (Wisconsin): Did I understand cancer cells were not killed in the same temperature as the tissue cells, that they had resistance greater than normal tissue cells? They are embryonic cells and supposed to be killed at a low temperature and they are not.

DR. KOLISCHER: Not to our knowledge.

DR. BROWN: That has always been taught.

DR. KOLISCHER: The microscope doesn't lie.

DR. ANDREW SARGENT (Hopkinsville, Ky.): Can't the nerves be blocked by the use of cold, by the use of ice or ether?

DR. KOLISCHER: Not very successfully.

DR. MORRIS A. HERSHENSON (Pittsburgh, Pa.): Did I understand you to say the frequency of alternations of high frequency current is not a factor in the amount of heat produced?

DR. KOLISCHER: No; you see it is a very simple thing. Heat is produced by the amount of current resistance; the amount of current is not varied by frequency. The same amount of current is carried through all the time.

DR. HERSHENSON: I want to know if I may say something on this.

CHAIRMAN KOBAK: No discussion, only questions.

DR. MOREY (Denver, Colo.): Doctor, what is your after-treatment after the tumor has sloughed away? For instance, say it was an epithelioma.

DR. KOLISCHER: It all depends on the location. For instance, we don't have to be afraid at all to produce a tremendous effect on the lip or cheek, because after a few months you will find a little bit of indentation only. The movable tissue on the face draw together without trouble. In other places you may finally have to resort to a plastic operation.

DR. MOREY: I had a patient, a little woman about 73 years old, with an epithelioma in the middle third of the left leg on the outside. I anesthetized it with a local anesthetic, coagulated the tissue and it sloughed out in about two weeks' time, but it took three months or more to heal up. I used ultra violet with the air-cooled lamp, but I wondered if I should have used something else in the way of x ray.

COMPARATIVE VALUE OF X RAYS, DIATHERMY AND RADIUM IN UROLOGY*

EDWIN W. HIRSCH, M. D.,
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When one is confronted with a tumor of the urinary bladder, he also is compelled to ask the query of himself, what can I do for the patient that will accomplish the most good. Various methods have been tried of which surgery, surgical diathermy, radium and x rays either singly or in combination, have proved to be useful. It is fortunate indeed that several schools have employed some favored proceedure exclusive enough of all other methods, to allow us to compare their tables of experience and results. Cases are being constantly reported for which good results are acclaimed in which surgery, x ray and radium or surgery, surgical diathermy and radium are employed and in either case we wonder what single force should be credited and what is the comparative value of each.

There are several groups of case records which are worthy of close study. The records of Young were studied principally for the results with surgery, surgery and radium, radium and fulguration. Barringer's tables showing the usefulness and limitations of the use of radium is one of the outstandiag statistical records. Corbus and Kolischer, who have championed surgical diathermy, are the best authorities on this potent force. Bumpus has an interesting set of figures in which various combinations of methods were used, and Mann has an excellent table showing the position which x rays occupy in the treatment of bladder malignancy.

Before we are guided too largely by the power of figures, we must remember that single tumors respond more easily to treatment than multiple tumors of the same grade of malignancy; tumors which involve the vertex or lateral wall are more amenable to treatment than those on the trigione or close to the ureter. Tumors of equal size may be compared with each other and the age of the patient as well as the grade of malignancy of the tumor must be considered before conclusions can be drawn evaluating the merit of a certain method. The suggestion made by Kretschmer at the American Urological Association two years ago that a cancer index should be established wherein would be recorded every reported bladder malignancy, the type and size of tumor and the result of treatment would be of inestimable value. With such a large group of statistics we could determine the value of the various methods of treatment. Nor should unwise or unjust criticism be registered against radium because it has been employed in hopeless cases. Barringer has wisely refused to operate upon this class which he terms "surgical derelicts" and recommends a suprapubic for relief only. Cancer in its terminal stage is no more remedial to treatment than is a markedly advanced tabes even though our treatment for syphilis is efficacious. Patients with a markedly advanced carcinoma of the bladder will live as long without as with treatment and only palliative measures should be resorted to in these cases.

SURGERY

Young operated upon 63 cases and kept 38 per cent alive one to ten years, and 8 per cent alive over six years. Lower, employing the same procedure, was able to keep alive 7 per cent of his cases over six years. The figures of these two schools tally close enough to show that the immediate mortality of surgery is rather high and the dead and recurrences in the first year run from 30 to 50 per cent. Bugbee believes that the end results of resection are not favorable. Bumpus records an operative mortality

*Read at fifth annual meeting, American College Physical Therapy, Chicago, Oct. 20, 1926.

of 11.2 per cent and states that if cases live into the third year they have a good chance for recovery. However, the large mortality in the first year following surgery, does not speak in its favor.

X RAY

One of the best series of cases in which the value of the x ray was tested was run by L. T. Mann of Mt. Sinai, N. Y. In 19 cases, he had 13 recurrences, and 9 were dead in two years or less. His results were equally discouraging when x ray and radium or x ray and cautery were employed. He concludes that cure of malignant growths of the urinary tract by deep x ray therapy is a very infrequent occurence; that alleviation of symptoms occurs almost as infrequently as cure and is in most cases temporary. There does seem to be greater prolongation of life in cases treated by deep x ray than in cases not so treated.

RADIUM

Barringer has done a most admirable piece of work in treating carcinoma and papillomata of the bladder by radium. In a series of 29 cases the dead and recurrences numbered about 50 per cent, but the remainder did well when the bladder was treated by radium intravesically, and these bladders remained clean one to four years after operation. As a result of this experience Barringer formulated two rules for judging whether the case should be handled suprapubically or through the cystoscope. Growths confined to and around the bladder neck as papillomata and pedunculated papillary if pedical can be reached and infiltrating sessile growths of no more than 2 cm. in diameter may be handled transurethrally. Growths other than the above by the suprapubic route.

DIATHERMY

Corbus and O'Connor in a series of 28 cases had an immediate operative mortality of 3.5 per cent. In 20 cases there were no recurrences and all were free from distressing urinary symptoms. The figures represent far better results than obtained by any other method used singly or in combination.

Now having weighed in a cursory manner the comparative value of the present day method of treatment we note that those who formerly adhered rather closely to surgery exclusively, now employ radium, diathermy or x ray in combination and have somewhat bettered their results. Since all these agents are powerful destructive forces they can harm as well as help and until the position of x ray is more definitely proved of value, it should be used most reservedly and cautiously. Surgical diathermy has the value of surgery in that it can remove diseased tissues and kill cancer cells at the same time and the depth of its penetration is more accurately determined than that of radium.

The questions which we originally propounded—when should we employ surgery—is x ray of value—what are the indications for radium—is diathermy the best form of treatment—should the bladder be opened or treated transurethrally—may now be answered. Small single growths easily seen near the neck of the bladder may be treated through the cystoscope by aid of the Bugbee electrode employing diathermy, or by the insertion of tiny gold implants of 0.5 to 1 millicurie of radon (radium emanation) through the Muir applicator. Larger growths may first be exposed to the action of radium salt in a tube through the Corbus or Young radium cystoscope and followed by surgical diathermy. Young has pointed out that radium causes resistent tumors to melt under the high frequency needle when previously exposed to radium. If the growth is larger than 2.5x2.5x1.5 cm. or multiple the bladder should be opened and either diathermy, radium or both may be accurately applied. Opening the bladder suprapubically has the advantage over the operative cystoscope that in the latter the field of vision is small and if the tumor is bleeding, it is impossible to employ careful technic. Excision should be employed when the tumor involves the peritoneum and is

situated in the dome of the bladder (Scholl). If radium has previously been used in the case, surgery should not be attempted as the postoperative result will be poor (Bumpus).

SUMMARY

Tumor of the bladder is a local affection and if the growth can be destroyed early there is a good chance for cure. Bladder tumors do not metastesize.

In general, bladder tumors of any size should be originally treated by opening of the bladder and with an electrically lighted retractor the growth should be clearly seen so that diathermy, radium or surgery may be accurately employed.

If surgical diathermy is used and the tumor is of considerable size, the heavy type apparatus must be used; that is a machine capable of rendering 4,000 m. a. continuously.

Radon enclosed in tiny gold seeds is of value in malignant type of tumor.

The general condition of the patient must be considered before employing any procedure. Patients with profuse hematuria, those who have shown a rapid loss of weight and those with a myocardial affection should be considered as poor risks.

Surgical diathermy or surgical diathermy plus radium offers our best method of treatmet, and the number of years added to patients' lives by their use and the test that it has stood entitle them to be classified as valued methods of treatment.

DISCUSSION

Dr. A. David Willmoth (Louisville, Ky.): This is an interesting paper, especially for the surgeon. The malignancy of tumors of the bladder and the risk of mistaking them for benign growths is a subject not far beyond recall from any of us. It is also interesting from the viewpoint of the work that was earlier attempted in attempting to coagulate these tumors, or fulgurate them, as it was commonly termed then, through a urethrascope in which the inability to know just how deep you were going or perhaps in some instance the anxiety of the surgeon to do a good piece of work, terminated in a fistulous tract between the bladder and the rectum. I have seen one who had a tumor fulgurated. There was no recurrence of the tumor. Whether it was cancer or not I do not know, but I do know when the patient came to me he had a fistulous tract from the bladder to the rectum with all of its troubles and with its difficulty of closure. Personally I have been of the opinion for several years that the proper method of attacking these tumors was through the suprapubic route. I think it is rather risky to conclude that you can deal with probably a malignancy through a urethrascope. If I had a tumor of my bladder, I most certainly would want the surgeon to open the bladder and look at it and deal with it in a surgical way. I would not want him to take a chance on treating me through a urethrascope, and then some months later say to me that he was sorry, but he probably didn't get as much of the growth as he should have. That would be a very great disappointment, of course. I would rather in my own work go through the suprapubic route and attack these tumors, because I think we can see what we are doing, we can know better how much tissue we are going to destroy if we are going to do it with electric coagulation, which I think is the best way.

We are leaving out of the discussion now the x rays and so on and I know exactly what I am doing and how deep I am going. You are dealing with a condition here that you may sooner or later find is malignant, and if you are going to strike it at all, you had better strike early and strike it thoroughly, unmercifully, because you are going to get a patient well or you are going to lose him one of the two, depending pretty much on what you do the first time. There is the risk of going entirely through, as I said a moment ago, and producing adhesions between the rectum and the bladder in the male. Of course that wouldn't happen in the female. You are fighting a tumor there, but in the male there is the risk, as the case that I had come to my office where the anxiety of the surgeon in fulgurating this bladder tumor had caused him to go so far that adhesions took place and he had this fistulous tract. That has been some three years ago, and previous to that I had done some work through the suprapubic route and after that case I decided I would never again go through the cystoscope for any tumor in the bladder I would rather open up and know just what I am doing.

This is an exceedingly interesting subject, as is all tumors that tend to become malignant, and I am very glad to have heard the doctor's presentation of the subject.

Dr. Hardy H. Smith (Ft. Smith, Ark.): Last summer I happened to be at the Mayo Clinic and saw some

work there. I saw a series of tumors, or saw where they were supposed to have been. They were small; they said they were all small, and single, and recurrence hadn't happened in nine months or over. Several of them had come back after one, two or three years, and some six to nine months, and there had been no recurrence of them. They used diathermy in practically every one of them. I saw them before they used diathermy and afterwards and it was rather nice to see the results. All of them used the cystoscope, none of them suprapubic.

Dr. Edwin W. Hirsch (closing): There was quite a discussion here in Chicago some years ago between the various factions, whether the bladder should be opened or whether it should be treated through the cystoscope or cystourethrascope. Of course it looks good to see treatment through the cystourethrascoep and it is good if you have a small growth about 1 cm. in diameter and height, or two small ones. possibly three where they are easily accessble. If you have a growth that is an inch or two or five or six in the bladder, it is almost impossible to tackle them through the urethra. You can have a growth that is too large to handle by any method and it is best to leave such a growth alone. If you open up the bladder and find the growth itself larger than you had thought it was by your cystoscopic observation, it is better just to put in a suprapubic tube and give them the suprapubic fistula and let them go at that. If you find the growth is infiltrated through the bladder wall, very likely it is infiltrated underneath the bladder and you will not get any result, and such a case as that should not be credited or discredited to any of our known methods of treatment.

I have handled through the urethra small growths, pinhead size, and larger, up to 1 cm. and near the bladder neck.

Dr. Willmoth asked me if I thought tumors near the bladder neck were less malignant than those on the vertix, lateral wall or dome. I don't know if anybody has collected any statistics to show that the malignancy of a tumor varies with its position. The tumors of the bladder have been classified accordng to their malignancy in types 1, 2, 3 and 4. It must be remembered that all bladder tumors have the potentiality of becoming malignant. Some are benign and will always stay benign, but it is possible for benign tumors to spread all over the bladder, too, and you can have so many benign tumors over the bladder that you have a mass of tumors and it is almost as bad as if it were a malignancy. It is a better method of treatment if you have multiple tumors or tumors of any malignancy, to open them up suprapubically. Some men have advocated snaring off a piece with a wire snare or the like. Some have spoken against the method because of its danger of spreading the cancer around the bladder. I have tried a method of putting a high frequency through the snare and pulling it off. I think it is safe to make your judgment according to what you see through the cystoscope. If you see at the base of the bladder where the pedicle is attached to the bladder that it is infiltrated, you have a right to presume that that tumor is malignant. If you have a large tumor, you open up the bladder. If it is a small tumor, you treat it through the urethra.

EDITORIAL

ARCHIVES OF PHYSICAL THERAPY, X-RAY, RADIUM

A Journal of Ideas and Ideals.

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Chicago, Illinois

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THE FUTURE OF PHYSICAL THERAPY*

The future of physical therapy rests with us. It is a problem of education. Our society is composed of physicians who are using physical agencies in the treatment of disease, in combination with medicine and surgery. We must strive now more than ever to bring this subject to its proper place in the medical profession. This can only be done by redoubling our efforts to properly educate medical students, physicians and technicians. The medical student now is supposed to have in his premedical course a thorough training in physics. Too often this is not the case, and without this training physical therapy can not be understood. The medical schools should insist on their entrance requirements including a thorough training in physics and biophysics. Since the modern medical school curriculum is already too crowded to include these subjects they should be premedical. Most schools now require for entrance at least two years of work in an approved college or university following the completion of an accredited high school course. The college credit presented should be made to include as many semester hours in physics and biophysics as in chemistry.

The first two years of the medical course are devoted very largely to the study of the fundamental branches, and it is believed that in the course in physiology the effects of the physical agents of heat, water, light, electricity massage and exercise should be thoroughly taught.

In the third year the principles of medicine and surgery and their allied specialties are taught in lectures and recitations. I believe that there should be in each medical school a special sub-department of Physical Therapy. This should be under the division of medicine and part of the time now given to therapeutics should be devoted to lectures on physical therapy. These lectures should be compulsory, and not elective. Eight one-hour lectures should be a minimum requirement.

In the fourth year instruction is largely clinical, and in dispensary and ward clinics, part of

*Presidential address as delivered at fifth annual convention, October 20, 1926, Drake Hotel, Chicago.

the time should be devoted to demonstrations of the applications of physical measures to patients. In order that all students should receive this instruction, this should be one of the required clinics in the dispensary work in medicine, and in surgery including orthopedics.

The rank of the teacher in this subject should be that of Associate in Physical Therapeutics.

In the education of physicians to properly appreciate physical therapy there are four methods: (1) through the medical society meetings, (2) in the clinics, (3) through the medical journals, and (4) by post graduate instruction. Our society has given a good demonstration of what can be done in medical society meetings. We should strive to have our local medical societies devote parts of their programs to physical therapeutics. As many of the claims for physical therapy in the past have been exaggerated, now that physical therapy is on the crest of recognition everywhere, so papers should be conservative and sane.

This society should work for the establishment of hospital clinics for instruction purposes. This can only be accomplished if we work as a unit and as individuals to establish the requirement for hosptals, that a physician be in charge of physical therapy departments. In many of our hospitals today these departments are in charge of untrained technicians. In the 1925 annual report on hospital standardization of the American College of Surgeons, under the x ray department, it is stated that they require the supervision of a medical radiologst for these departments in all instances. This report then says:

"This is essential from the standpoint of administration and development of the department, the carrying on of complicated technique and particularly the accurate interpretation of the findings."

We believe that this applies equally to the physical therapy department and until we have a minimum requirement of a physician supervising the hospital physical therapy clinics, clinical instruction in this subject will not be complete.

Post graduate instruction to the physician must be established in our medical schools before we can condemn the manufacturers of physcal therapy instruments for giving instruction classes. This is being done in many places, although in the last educational number of the *Journal of the American Medical Association* only five schools were listed as giving this instruction. We expect to have a post graduate course at the Northwestern University Medical School and others are starting also. A minimum of six weeks should be given with lectures and clinics and the classes limited to small groups.

Last but nearly the most important thing in the progress of physical therapy is the education of technicians. There are in the field today two classes of technicians—one a highly trained group of women doing excellent work with high standards and ideals, and second, a group of poorly trained technicians with no ideals except to make money—many of these are running individual offices where they treat patients even though not referred by physicans.

The traning of technicians should be done under university supervision. The course should include a full school year of eight months. The admission requirements should be a high school education and the completion of a course in a recognized school of physical education or a school of nursing. A schedule of hours should include a minimum of 120 hours of anatomy and physiology, 45 hours of electrotherapy, 20 hours of hydrotherapy, 10 hours of occupational therapy, 80 hours of theory and practice in massage, 48 hours of theory and practice in therapeutic exercise, 20 hours in light and heat therapy and lectures on orthopedic conditions, communicable diseases, dental diseases, dermatology, diet in disease, gynecology, ophthalmology, otology, rhinology and laryngology, pediatrics, mental and nervous diseases and veneral diseases.

In order to establish some standard for technicians I believe this society should take some steps toward the establishment of a registry for physical therapy technicians along the lines of the American Registry for Radiological Technicians which is functioning now. The object of this registration is to bring together in one group the experienced technicians and to correlate their vocation as an ethical subsidiary to physical therapy. There should be appointed a board from the several physical therapy societies, for the purpose of passing on the eligibility of candidates, arrange for their examination, seek to effect the regulation of all technicians by means of proper state laws, and serve as a source of information as to proper training schools for technicians.

The qualifications of technicians should include a preliminary training the equivalent of a high school course, completion of an accredited nursing or physical education course, and a course in a recognized physiotherapy school, and an assistantship for at least two years under direct medical supervision.

A physician of recognized ability in the district nearest to the applicant would be designated to conduct the examination and report to the board. The examination would be written and practical.

A certificate suitable for framing would be issued to all candidates who have passed the examination. This could be revoked at any time for cause and renewed by annual registration.

This registry will be a success if the various physical therapy societies and manufacturers of instruments will support it as is being done with the x ray registry.

The *American College of Physical Therapy* is today the largest society of its kind in the country. We must not, however, be overenthusiastic. In order to achieve our maximum usefulness we must strive for better things. These suggestions are only a few that will help to make the physical therapy greater in the future.

JOHN STANLEY COULTER. M. D.

PHYSICAL THERAPY IN MALIGNACY

The treatment of cancer is ever an urgent problem. Intensive research through the centuries has failed to solve the etiology of cancer; as much mystery remains as before the Christian Era. There are so many varieties of malignant disease that there may be a multiplicity of causative factors.

To quote from the statement of the International Meeting on Cancer Control, held at Lake Mohonk, N. Y., in September, 1926:

"The causation of cancer is not completely understood, but it may be accepted that for all practical purposes cancer is not to be looked upon as contagious or infectious.

"Cancer itself is not hereditary, although a certain pre-disposition or susceptibility to cancer is apparently transmissible through inheritance." (1)

At the present time cancer is apparently on the increase, due to two recognized factors. Diagnosis has been more exact with the advent of x ray determination, more frequent biopsy and necropsy studies. Secondly, the advancement of medical science has decreased mortality in the diseases of earlier life so that more people attain to the "cancer age." Whether there is also an actual increase in malignant disease over and above these two factors has not been demonstrated.

Before the discovery of x ray and radium as therapeutic agents, surgery was the only defense against malignant growths. Patients who dreaded mutilation by the knife and those with recurrences after operation, as well as cases with hopeless, inoperable lesions, had no form of treatment available; no hope of palliation.

With the advent and development of radium and x ray this hopeless picture has changed. Surgery was and still remains a powerful weapin, but with these new physical adjuvants the struggle against malignancy is more hopeful. Cases discovered early (and these are only too few) can be permanently cured by radium and x ray alone or in combination with surgical measures. The advanced and recurrent cases are assured of relief of pain and prolongation of life. To quote further from the statement of the International Meeting on Cancer Control:

"The most reliable forms of treatment and, in fact, the only ones thus far justified by experience and observation depend upon surgery, radium and roentgen rays." (2)

We must remember the role of another useful physical agent—ultra violet light—in upbuilding cachectic patients and stimulating the hematopoetic system; also in many cases alleviating pain.

Of course, these physical measures require skill and experience in their application. Radium and roentgen rays alike cause destruction of malignant cells, although their precise biological effects may differ. It has been claimed that the shorter rays of radium act on the cellular tissues while roentgen rays have more effect on the connective tissue elements. However, both agents are mutually helpful; radium in accessible lesions where the element can be topically applied and x ray with its larger incident portals in treating the surrounding lymphatic areas. Radium undoubtedly is the more powerful agent; it is also more flexible and is capable of precise application. But this is true only of sufficiently large amounts of radium skilfully handled. The x ray accomplishes far more than an insufficient amount of radium can achieve. The best results usually accrue from the combination of the two methods.

Future progress will result along two lines of endeavor; firstly, from continued dissemination of information among the public regarding the very first symptoms of malignancy, so that more cases are reached in a curable stage. The general practitioners are alert and refer cases early, but there is a fatal delay among the patients themselves. As a concrete example: One-third of all cancer in women occurs in the cervix and uterus. Radiation treatment of cancer of the cervix has achieved brilliant results; well over 50 per cent of early operable cases are clinically cured. But consider the small number of early operable cases that we see. I previously reported a small series of recent cases at the Howard A. Kelly Hospital—55 in number; only 5, or 9 per cent, were early operable conditons. (3) Ward (4) also reports the cancers of the cervix treated at the Howard A. Kelly Hospital during 1921 and 1922; 232 cases in all and only 14, or 6 per cent, were early operable conditions. This is truly a deplorable situation. Propaganda has yielded far better results in breast cancer and bone tumors, but much remains to be accomplished.

The second line of endeavor lies in the perfection of apparatus and technique; here we are steadily progressing. As one instance I might mention the recent innovation of gold and platinum covered radium emanation tubes for implantation purposes, which is accomplishing so much in treatment of cancer of the tongue and buccal cavity.

Finally, the best defense against malignancy consists in the correlation of surgery, the cautery, surgical and medical diathermy, radium, roentgen rays and ultra violet radiation.

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(1) Statement by International Meeting on Cancer Control. Am. Jour. Roentgen. and Rad. Ther., XVI, 5, Nov. 1926.

(2) Statement by International Meeting on Cancer Control. Am. Jour. Roentgen. and Rad. Ther., XVI. 5, Nov. 1926.

(3) Fricke, Robert E.: *Radiation Therapy in Carcinoma of the Uterine Cervix.* Arch. of Phys. Therap., X Ray, Rad., 7, 189, April, 1926.

(4) Ward, Grant E.: *Radium in the Treatment of Cancer of the Cervix Uteri.* Jour. A. M. A., 87, 21, Nov. 20, 1926.

ROBERT E. FRICKE, M. D., Baltimore.

HIGH BLOOD PRESSURE

Under a section, entitled "Modern Technique and Treatment" in the January 1 issue of the *Lancet*, is contained a special article on the treatment of high blood pressure. After entering into a discussion of what high blood pressure really is, some interesting facts are given in resume form on preventive or prophylactic measures, diet, rest and exercise, baths, high fre quency currents, and drug treatment.

The parts on rest and exercise, baths and high frequency currents are of special interest, and therefore are quoted ver batim for the benefit of our readers.

"*Rest and Exercise.* High blood pressure is undoubtedly reduced by rest in bed, as, indeed, it normally is in the recumbent position, but this is a temporary result, and with a return to ordinary life it resumes its previous character. Still a full night's rest is always beneficial, and occasionally a whole day in bed does good. The heart may thereby be relieved of strain, but the underlying factors of the raised blood pressure are not likely to be influenced, except, perhaps, psychologically. Rest in bed may become necessary for subsequent myocardial failure, but this is another story. Exercise of various kinds, especially in the fresh air, according to the patient's powers and never so extreme as to cause dyspnoea or other distress, is advisable both bodily and mentally. Failing opportunity for exercise in the open, breathing and other forms of indoor exertion have their place, as has massage in certain circumstances.

Baths. On a priori considerations hot baths would seem suitable, but their value has not escaped some criticism, for they raise the systolic pressure slightly while lowering the diastolic pressure to a greater degree, and thus increase the work of the heart. Cold baths are undesirable, as they raise the blood pressure. Patients are often greatly improved and their pressures lowered by a visit to a spa, where facilities for several forms of treatment, freedom from worry and the psychological effect of change play a part. Residence in a warm climate, a prescription more easy to give than to carry out, exerts a beneficial influence.

High frequency currents lower the pressure for a time; diathermy is said to keep the pressure down much longer, so that eventually monthly treatments are sufficient to maintain a reduction permanently down to a level appropriate for the individual patient. Ultra violet rays are also stated to have a similar effect; in this method, as in diathermy, the mode of action is not certainly known, but Sir Thomas Lewis' work suggests that a histamine-like body is liberated from the damaged skin. Lumbar puncture and venesection at once reduce the pressure for a short time, and may be useful in the emergencies of hyperpietic crises, but their effect is very transient."

PROGRAM

For the Fischer Monthly Physiotherapeutic Lecture Clinic, Tuesday, March 8, 1927.

"A New Physiotherapy Treatment for Arthritis and Neuritis," 10:00 to 11:00 a. m., C. M. WESTERMAN, M. D., St. Louis, Mo.

"The Use of Monopolar Current in Skin Blemishes"—a Demonstration on Patients, 11:00 to 12:00 a. m., A. E. SCHILLER, M. D., Detroit, Mich.

"A New Physiotherapy Treatment for Arthritis and Neuritis"—Demonstration of Technic, 1:15 to 2:15 p. m., C. M. WESTERMAN, M. D., St. Louis, Mo.

Surgical Diathermy Clinic at Cook County Hospital, 2:30 to 4:00 p. m., DISRAELI KOBAK, M. D., Chicago, Ill.

Dr. Westerman was scheduled to demonstrate, on patients, his technic in Arthritis and Neuritis, at our January Lecture Clinic, but at the last moment was compelled to cancel his engagement because of a critcial case which re-

quired his constat attention. If you had planned to attend his lectures in January, by all means arrange to do so at this March meeting.

Skin blemish operations are of interest to most physicians and surgeons today. Dr. Schiller's technic is well worth the study of any electrotherapist, and will be demonstrated on patients.

Dr. Kobak's wide experience in the field has been of great benefit to the visitors at these clinics, and we urge all physicians who possibly can to attend the demonstration at the Cook County Hospital.

H. G. Fischer & Co., Inc.

INTERNATIONAL ABSTRACTS

The Treatment of Cervical Cancer by Radium Emanation. J. Muir, M. D., the Journal of the Maine Medical Association, Vol. XVII, No. 9, Sept. 1926.

Radium was first applied to the cervix by Abbe; technique was developed in France. It is of peculiar benefit to women because of its aid in cancer of the cervix. Kelly did much to popularize cervical application of radium in the United States.

Examination of uteri excise dafter being radiated made by Frankl and in Wertheim's clinic. "The areas directly exposed to the rays showed the first changes on the third and fourth days; the influence of the rays was greatest between the fifth and seventh days; the rays were no longer effective after the fortieth day. when the genueeptors of the cells became active and caused proliferation."

Areas indirectly treated were slower in showing the changes and the effects of the treatment wore off sooner. Normal tissues, blood vessels, nerves, cervical mucous glands, etc., seem to be little affected, indicating selective action by the rays.

Control of extension and metastasis is a most important phase of the clinical problem. Sterilization of the zone d'ensemencement latent—that is, the tissues directly surrounding the area of known malignancy—has been attempted by Regaud, by means of many centers of radioactivity. He condemns the method of fractional dosage. The limit of dosage possible in the vagina placed by Proust at 45 mi. destroyed.

The author follows the general plans of the French gynecologists, but has a special technique which combines all of the advantages of the French method, while it eliminates some of the drawbacks.

Emanation offers many advantages over radium salts in nearly every case where therapeutic emergencies make it desirable to use radiation.

The three principles of this therapy are: rigorous asepsis; proper distribution of highest possible dosage without injury to surrounding tissue; avoidance of necrosis by proper filtration.

Occupational Therapy for the Crippled. J. D. Trawick, M. D. Kentucky Medical Journal, Sept. 1926.

Occupational therapy to be effectually employed must be preceded by anatomical reconstruction. It is of equal, sometimes greater importance, than the surgical or physical measures used.

There are two distinct fields—the one occupied by the very young child, the other by the cripple of more mature years. Play is the occupational part of the agent in the child. Apparently marvelous results are being obtained in the correction of deformities, for instance following anterior poliomyelitis. It is of great value to the arthritic cripple, where atrophy has occurred. with loss of muscle tone and destruction of cartilage in joints; in employment the pain forgotten and use promotes function. All hospitals which receive a number of cripples should be equipped not only with complete physiotherapy outfits, but provide space for occupational curative shops. It necessitates

a trained occupational therapist with a great amount of patience.

If a part needs extension or flexion, or rotation, or abduction, the doctor should so direct. and he must watch for reactions, to determine the duration of treatment and the force to be used by the therapist.

The Treatment of Birthmarks by Physical Agents. Joseph Jordan Eller, M. D., Medical Journal and Record, Nov. 17, 1926.

The author states that the older methods of therapy employed in the treatment and eradication of birthmarks have been replaced by methods which are more under control of the therapeutist and which uniformly give better results. The physiotherapeutic measures that are used are electrolysis, trichloracetic acid applications, x rays, radium, carbon dioxide snow. Kromayer light and surgical endothermy.

In the treatment of brown pigmented nevus without hair, carbon dioxide snow gives the best results in the large lesions and application of trichloracetic acid in the small ones. Electro-desiccation is also used for the removal of this condition, but with this agent there is apt to be more scarring.

In brown pigmented nevus with hair the hair must first be removed by means of electrolysis. Quite frequently the lesion disappears without further treatment. If any of the pigment remains it is readily removed with carbondioxide snow or trichloracetic acid. X ray and electro-desiccation is contraindicated because of scarring.

Black pigmented mole without hair is a dormant melanotic cancer and should be treated as such. If it is in an area not subject to irritation and does not show any sign of growth, no treatment is advised. On the other hand, should there be an indication for removal, only the most radical treatment should be undertaken. The best results are obtained by removing the lesion without touching it. This is done by the use of the endotherm knife circling wide for about a half-inch to an inch outward from the lesion and then cutting down for a half-inch or more underneath, removing this whole mass of tissue with the mole intact. A day later radium heavily filtered is applied to the treated site as well as to the glands which drain the affected area.

Nevus Verrucosus is a warty birthmark which is best removed by a deep application of electrocoagulation.

Nevus Flammeus. port wine marks, are usually situated on the face and vary in size and color. Many authorities have reported very poor results with x ray and radium and the author feels they are contraindicated. He reports a few cases of cures by the use of the Kromayer light with pressure, but recommends carbon dioxide snow as the treatment of choice. He applied the snow by the Lortat-Jacob method.

Stellany nevus is best treated by electrolysis. As a rule one treatment to the center of the lesion using two to three milliamperes of current and leaving the needle inserted until this area becomes blanched, will suffice to cure this condition.

In angiona cavernosum the deep vessels, especially the veins, are involved. Radium is the treatment par excellence and gives by far the best results. Carbon dioxide snow and bipolar endothermy are other methods of treatment, but the author recommends radium.

Nevus Vasculosus is a type of angioma in which the lesion is erythematous and is elevated slightly above the surface of the skin. Radium is by far the treatment of choice in this condition using filters of one to two milliameters of aluminum.

Studies of X Ray Effects. The Prevention of Pigment Formation in the Hair Follicles of Colored Mice with High Voltage X Ray. R. T. Hance, PH. D., and J. B. Murphy, M. D., the Journal of Experimental Medicine, Vol. XLIV, Sept. 1, 1926.

In order to gain some knowledge of the biological action of the different wave lengths of x ray, some experiments were made on black-haired mice, so that any change in color might be more easily detected. Two and one-half months after the exposure to the x rays upon the abdomen of the mouse, white hairs appeared upon its back.

Comparatively little is known about the pigment production in hair. Hair is said to be pure white only when pigment is lacking and air s present between the cells of the medulla and the cortex; where the air is missing the hair appears gray, never white.

Whatever the actual processes responsible for the presence of pigment in hair, in some way hard x rays interfere wth it permanently

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Diathermy—Its Physics and Clinical Indications. Richard Kovacs, M. D. Medical Journal and Record. Nov. 17th, 1926.

The author classifies the different forms of therapeutic electricity as follows: Galvanic, faradic and sinusoidal, which are currents of low tension, and the high frequency current which is of high tension.

Galvanism, which is electricity of constant flow and low tension, acts on the human body as a chemical substance (electrolyte) by causing definite action round and between its poles and the wandering of ions in the interpolar path. The action at the poles is stimulation and reflexes irritation and besides the positive

pole is acid caustic and thus hardens tissue, stops bleeding and repels bases, while the negative pole is alkaline caustic, softens tissues, increases bleeding and repels acids.

When the galvanic or constant current becomes interrupted or rhythmically reversed (sinusoidal current) over muscular parts of the body, gentle or vigorous muscular contractions are produced and this mechanical action is utilized for the treatment of muscular atrophy or paralysis or for tissue stimulation.

The faradic current is an irregularly alternating current and causes a tetanic contraction of normal muscles.

All these forms of electricity have a superficial action on the human body; because of their polarity action, the muscular contractions and the painful sensory stimulation caused, they cannot be employed by sufficiently high tension to penetrate deeper parts. D'Arsonval of Paris made the discovery that an increase of frequency causes a decrease in the strength of contraction until at a frequency of 10,000 per second absolutely no effect is produced upon either the motor or sensory nerves.

High frequency currents travel through the body tissues as solid conductors and subject to the laws of electrothermic reaction, produce heat within these conductors in proportion to their resistance. The patient has no other sensation except that of warmth, and this can be easily regulated from extreme gentleness to the cooking or destruction of tissues.

The essential parts of any high frequency apparatus are, a supply of alternating current and a high frequency current which raises the voltage of the current by means of a step up transformer and its frequency by a condenser-spark gap arrangement.

There are three main types of high frequency machines, either of which can be used for either medical or surgical action, and can be applied either from two terminals or one special terminal.

The modern diathermy machine, producing oscillations of one or two millions per second at a comparatively low voltage, makes it possible that currents from 500 to 3,000 milliamperes are driven through the tissues of the body without any other sensation than that of heat. The body tissues act as solid conductors. The degree of heat will depend upon the strength of the current and the size of the electrodes. The same current will produce a higher temperature under a small than under a large electrode. The application of electrodes is important.

The local effects of diathermy are based on the fact that heat is generated within the tissues.

Heat applied externally cannot penetrate deeply. The heat of diathermy is produced within the tissues by the transformation of electrical energy into thermic energy, and is produced faster than the heat regulating mechanism can dissipate. Human tissues can stand up to about 118° F. of heat without damage.

The clinical action of diathermic heat can be classified in four main groups:

1. Active arterial hyperemia and hyperlymphia, which increases both the local and general body metabolism.
2. Local relief of pain.
3. Antispasmodic action.
4. The bactericidal action.

Monopolar high frequency applications can be used with benefit in superficial neuralgias, mild forms of neuritis and subacute forms of polyarthritic.

The employment of diathermy as a destructive agent has a very wide field. The aim of surgical diathermy is to produce a varying amount of electrical heat either for the drying up (dehydration) or carbonization (fulguration) or complete termoelectric coagulation of the tissues.

Dehydration is accomplished by the monopolar application of the mild amount of high frequency current through a steel needle into the tissues with the effect that the tissue fluids slowly evaporate and the area treated converts into a dry mass.

Fulguration is the sparking of the tissues by monopolar application, causing a superficial cauterization from without in contrast to the dehydration from within in the former method.

Electrocoagulation is the method whereby a heavy bipolar current is employed and a very penetrating and immediately destructive current is employed. The heat produced comes from within and with sufficient experience can be made to act to great depths. Malignant growths when accessible can be attacked successfully by this method and has the following advantages over cutting operations: Operation is bloodless, less time required, very little shock, minimum of trauma, danger of metastasis reduced to a minimum, very little postoperative pain and toxemia, resulting scars are soft and pliable and there is perfect control to an area as small as a needle point.

On the Resistance of Gonococci in Regard to Temperatures Above 37° C. in Connection with Diathermy. P. H. van Putte, Acta Der mato-Venereologica, Vol. VII, No. 2

The author conducted experimentation in a series of cases of gonorrhea with diathermy. Before starting the treatment he decided to establish the resistance of the gonococcus to temperatures above 37° C.

The resistance of the organism to incubator heat and to the heat of diathermy were to be determined. The concensus of belief is that the gonococcus dies at

39° C. Wertheim contends that the organism will live at 40° C.

The work of Marcus and Santos-Boerner is quoted, giving the duration of viability for the gonococcus at various temperatures.

"The resistance to heat of gonococci *in vitro* is evidently much greater than it is generally supposed to be."

At 41.5° C. van Putte could still grow gonococci, and after six hours' heating at 45° C. a large majority of the strains were still viable.

The resistance of gonococci *in vitro* was as great for diathermy heat as for other forms of heat.

Concentrated Carbon-Arc Light a Simple Method to Improve the Efficiency of the Finsen Treatment. Savend Lomholt, M. D., O. B. E. The Lancet, Jan. 1st, 1927.

While Finsen's treatment of lupus vulgaris with concentrated rays of a carbon remains the treatment of choice for this disorder, the lamp has several disadvantages. The strong heat, resulting from the powerful heat rays of the carbon arc, prevents the raising of the intensity of the short wave irradiation above the amount produced by a carbon arc of 50 amps., 55 volts and filtered through 31 cm. of water. Finsen finally restricted himself to a water filter of 30 cm. length which he thought would remove all the infra red radiation of the light. It was later shown, however, that the increase of the water layer from 31 to 91 cm. diminishes the heat of the light column by more than 33 per cent. While this was arrived at experimentally, therapeutic tests gave a result which was in perfect accordance with this.

The conclusions are significant:

1. Water is an ideal filter to be used in carbon-arc therapy. It lets the efficient ultra violet rays pass untouched even through thick layers.

2. A water layer of 91 cm. absorbs almost all the infra red and a good deal of the outer red rays in the light—i. e., of rays of 7,300 Angstrom still about 50 per cent are absorbed. Calometric measurements showed that a light column, which has passed an apparatus of concentration with a water filter of this thickness, contains 30 to 45 per cent less heat than a corresponding column that has passed one of the original apparatus with filters of 31 and 15 cm. (Finsen and Finsen-Reyn lamps). The filter does not diminish the therapeutic effect of the light.

3. According to Sonne's investigations the absorbed infra red and red rays represent the part of the irradiation of the carbon arc most inconvenient for light therapy since they are absorbed in the uppermost layer of the skin in which very sensitive part of the body they produce a strong heating that gives to severe pain. Consequently, the elimination of them will permit an increase of the intensity of the irradiation which is considerably stronger than the said 30-45 per cent that is their part of the thermical energy of a carbon-arc light column, which remains after it has passed a water layer of 16-31.

4. Clinical and histological observation showed that it is possible to increase the biological effect of the concentrated carbon-arc light by using water filters thicker than the ordinary ones and this considerably more than indicated by the 30-45 per cent mentioned.

Diathermy in the Treatment of Otitis Media. S. J. Rubley, M. D., Monroe, Mich. Eye, Ear, Nose and Throat Monthly, Oct. 1926.

To bring a case of otitis media to a satisfactory termination avoiding involvment of the mastoid and surgical measures requires a painstaking investgation into the etiology of the case. The location of the ear, its proximity to the brain, the signioid sinus and facial nerve make complications far reaching and often disastrous. The etiology is usually to be found in the pharynx, generally starting with pharyngitis, rhinitis or tonsilitis.

Having made a thorough examination and an accurate diagnosis, Rubley employs the well-known medical measures, both systemic and local, such as medical instillations in the ear, hot and cold applications, incision of the drum when necessary, systemic tonics and purgatives.

In addition to these measures he advocates the use of diathermy and autocondensation. His methods are as follows: Place patient on autocondensation circuit. Then with a finger in the external auditory canal of the affected ear, the current is turned on and gently raised up to 350-500 milliamperes or to a degree of warmth that the patient and operator will tolerate. This heat is maintained at the maximum temperature for thirty minutes and repeated every second or third day. There is no danger of burning the patient because the finger of the operator is as hot as the ear. This method is generally used with children and infants. Free drainage must first be established.

In treating adults, where you have full co-operation of the patient, Ruzley uses an electrode especially made for each ear. These are made in the following manner: Warm paraffin is first inserted gently and firmly into the auditory canal and is then gently withdrawn and plunged into cold water. A plaster paris mold is then made and allowed to harden for twenty-four hours. Hot lead is then poured into the mold and a small nail is inserted into the molten mass to act as a binding

post. The lead impression is then smoothed down with steel wool and you have a neat lead electrode that exactly fits the ear canal.

In adults use straight diathermy. The indifferent electrode, a lead plate 2x3 inches, is moistened and placed on the opposite side of the neck from the affected side. This is connected to one pole of the bipolar current circuit. The lead electrode is placed in the lathered ear and connected to the other pole. Current is slowly increased to 350-500 milliamperes and continued for thirty minutes. Repeat every second or third day, or as often as the skin tolerance will permit.

In cases of bilateral otitis media, the same procedure is used with two electrodes, one for each ear. The current passes from ear to ear, each receiving an equal amount of heat. There is no indifferent electrode in this case.

Often the exudate becomes more profuse after the first two or three treatments, then it changes gradually to a less purulent and a more serous nature, gradually diminishing. The margins become active and the perforation starts closing.

The length of time necessary for treatment cannot be determined. The more chronic the condition is, the longer it takes to establish a cure.

A good electrode holder can be made by separating the metal ear tubes of a Bowles stethoscope and slipping a piece of rubber tubing over the tubes and the spring wired back in place. Solder binding posts onto the lower ends and you have a serviceable electrode holder. The patient should hold the insulated leads and not the metal. If he does this he may diffuse the current partly through the arms and shoulders.

Physiotherapy, Its Use and Abuses. Curran Pope, M. D., Wis. Med. Jour., Jan. 1927.

Every form of physical therapy has its peculiar and well recognized method of organization. The sources of the various energies, their action upon the normal individual and upon the pathological subject with all the variations of diseased states must be studied. For only upon the knowledge gained can we truly prescribe physical measures, even as we would those chemicals or what we call medicinal substances or drugs that are subject to the accurate measurement of the chemist or the pharmacist.

No man should *practice* physical therapy; he should *use* it in his work just as he uses any other therapy. It is not a thing to be trusted in unskilled hands. It possesses potent power for good, and like everything that possesses this power it has equally potent power for evil.

The author calls particular attention to the ignorance of some physicians in the manipulation of machines and the differention of the various types of currents.

When it comes to hydrotherapy, all other forms of physical therapy must bend the knee and bow the head in obeisance. It is useful in nearly every phase of medicine. The effect of the whirlpool bath is especially noteworthy and many times makes possible other treatments, such as diathermy with better results. However, diathermy is not a cure-all.

Today we are in the throes of a new era. It is an era when men are apt to misjudge and not to weigh, when they are apt to make of these remedies a panacea for the evils of flesh as well as of mind. *These methods have in themselves certain powers and capacities only as the intelligence of the physician may understandingly apply them.*

Experimental Nephritis Produced by Irradiation, F. W. Hartman, M. D., Adolph Bolliger, Ph. D., and H. P. Doub, M. D. Am. J. of the Med. Sciences, Sept. 1926.

The summary of the authors brings out the essential findings in experimental nephritis produced by irradiation.

Renal epithelium is readily damaged by high voltage roentgen ray applied through the abdominal wall with comparatively small changes in other organs. In young animals particularly the kidney changes are easily produced without causing the hair to drop out. In proportion to the epithelial damage an increase in interstitial tissue takes place which replaces most of the tubules and distorts those remaining. The bloodvessels from renal artery to small capillaries show thickening of their walls and many undergo complete endarteritis. The epithelial damage gives an opportunity for study of the acute and subacute tubular type of nephritis while the terminal lesion is a combined type of interstitial and vascular nephritis of extreme grade. The glomeruli are relatively well preserved. Work on dogs allowed of satisfactory functional studies throughout the course of the disease, and detailed experiments will appear in a later communication, but briefly the changes consist of albumin and casts in the initial stages, marked polyuria with low specific gravity in the subacute stage and gradual depression of dye excretion with marked nitrogen retention in the final stages. Constitutional changes consisted of hypertension and macular changes. The terminal periods were characterized by acidosis, vomiting, convulsions, coma and oliguria or anuria.

Electrocoagulation Snares—for Tonsil and Intravasal Surgery and for Benign and Malignant Growths, A. R. Hollender, M. D., and M. H. Cottle, M. D. Surgery, Gynecology and Obstetrics, Jan. 1927.

A new instrument, a simple modification of the Beck-Schenck tonsillectome is now employed by the authors

for the enucleation of tonsils with electrocoagulation. The technique of the operation is fully described for each tonsil.

The postoperative course is favorable. The local reaction is perhaps less than that following a clean tonsillectomy. There are no untoward systemic reactions. Healing occurs in the usual time, leaving softer scars and less distorted looking pillars.

Several tonsils removed by this method were studied microscopically. It was found that coagulation necrosis occurs at the site of operation extending to a depth of only two to three cells.

Electrothermic methods are as yet not extensively used in intranasal surgery. This is probably due to the fact that rhinologists have not acquainted themselves with the possibilities of surgical diathermy. The technique for intranasal coagulation is similar to that described for tonsil enucleation. A current of 200 to 300 milliamperes is ample, but if bone is to be removed, 400 to 500 milliamperes are necessary.

The intranasal snare is adaptable to use for small benign or malignant tumors anywhere, but especially if these are situated in the regions of the nose, throat, larynx, and eye.

The following conclusions are significant:

1. For tonsil enucleation, the method should be undertaken only by one who is thoroughly familiar with the Beck instrument and technique, as well as surgical dissection of tonsils.

2. The method insures a bloodless removal of the tonsils at one sitting with comparatively small danger of secondary hemorrhage and absorption of toxins by the lymphatics, and without the occurrence of sparking.

3. The nasal coagulation snare is well adapted for the removal of polyps or for partial removal of turbinates and does away with hemorrhage usually incident to these operations.

4. This instrument is of decided advantage for removing *en masse* small benign or malignant tumors.

5. The depth of the tissue coagulation which is produced by either the tonsil or nasal snare is minimal and sloughing is, therefore, negligible.

Newer Developments of Electrothermic Methods in the Treatment of Neoplasms. George A. Wyeth, M. D., Surgery, Gynecology and Obstetrics, Jan. 1927.

Wyeth holds that precancerous condtions, warts, moles, naevi, pigmented areas, keratoses, angiomata, etc., so located as to be subject to pressure or to repeated injury are likely to suffer a malignant degeneration and should be destroyed or removed. Their removal can the more earnestly be recommended since it can now be accomplished by the employment of the lighter dehydrating current, without the certainty of scarring by scalpel and without danger of mechanical dissemination of malignant cel's in the event that the benign lesion has already become active.

The author believes that high frequency has become of greater usefulness in surgery through the development and perfection of the endotherm knife. A case is reported in detail to show the technique of employing the endotherm knife which is valuable not alone in removing exceptional conditions as fibro-angosarcoma, but also in the treatment of malignancy of the breast, whether a benign or malignant tumor, is to be excised or a radical amputation is to be performed.

The fact that endothermy has proved so dependable in the removal of exceptional lesions which appeared to be entirely beyond the reach of all other known remedial agencies encourages one to believe that it will continue to offer, in all cases of accessible malignancy, a definite extension of surgery.

In the perfection of endothermy and the development of a definite technique in its operation there has been a very great extension of the limits of surgery's effectiveness in the treatment of malignancy, and in no other class of cases is this usefulness more clearly demonstrated than in cases involving the mouth. Naturally these newer methods cannot be described with precision by the employment of old terms and it is therefore in the interest of clarity and definiteness that the writer has suggested the use of the comprehensive term endothermy to mean the surgical application of high frequency currents and the acceptance of the word diathermy to mean their medical application.

The manifest advantages of this extension of surgery in the removal of neoplastic diseases are: the applicability of surgery to a much wider range of cases; the reduction of the danger of metastasis and the likelihood of recurrence; the quickness and ease of the application; the possibility of repeated operations; the absence of surgical shock; and a minimum of hemorrhage and trauma, with soft, pliable scar.

It will be seen that endothermy is not offered as a substitute for surgery. It gives to the surgeon a means of pushing further the limits of what may be done in behalf of the cancer sufferer and it protects him against many of the untoward concomitants of scalpel surgery in these cases.

Early in the paper, Wyeth calls attention to the already well recognized advantages of surgical diathermy, especially its ability to seal off lymphatics, and to cap sensory nerves. Thus the danger of metastasis is limited as is also the likelihood of mechanical dissemination.

Tuberculosis of the Spine: Early Diagnosis and Treatment. Hugh C. Trumble, M. C., M. B., B. S. (Melb.) F. R. C. S. (Eng.), The Med. Jour. of Australia, Aug. 21, 1926.

Several phases of this important subject are covered by the author, laying stress on diagnosis, symptoms, history, etc. The treatment is divided into general and local, although space is given to a consideration of the value of heliotherapy, and because of its appropriateness, this part is stated in abstract.

So amazing are the results in some cases, that it is hard to resist the conclusion that man has succeeded by the exercise of extraordinary skill in designing dwellings and clothing of a most unsuitable type in semi-asphyxiating himself. Not only does he largely put out of action the naturally magnificent heat regulating function of the skin, but he substitutes for the light, fresh, cool, radiant atmosphere which should bathe and stimulate this organ, one which is dark, stagnant, hot and moisture laden. Little wonder that in many cases the organism droops and wilts; little wonder that so handicapped it becomes an easy prey for the lurking enemy. Once this enemy has gained a foothold, it is time to adopt a mode of living more in keeping with the requirements of man in his native state. *"Retournons a la nature"* might well become once more a popular slogan. One has but to observe the changes which take p'ace when these tuberculous subjects are placed in the open air and the light of day, to realize how handicapped they were previously. The thin, pale, weary and flat chested sufferer, in an incredibly short space of time becomes plump, tanned, full of life and spirits and his chest appears to increase in volume from day to day, probably because of the increased respiratory excursus necessitated by the higher rate of metabolism, which in its turn is called forth by the stimulus to the skin of light and cold. The muscles generally waste much less than is usual in bedridden patients, probably because their heat producing function is exercised to the full.

In practice the patient is kept outside night and day, preferably resting on a wheelbed. He is encouraged to decrease progressively the amount of bed coverings, until he needs next to nothing except during excessively cold snaps. During the day he wears a pair of "shorts" and is otherwise fully exposed. Common sense is necessary to regulate the details of this exposure. It is not advisable to permit the hot midday sun to shine on his skin. In hot weather the play of sunwashed cool air is of more benefit than are the direct rays of a summer sun. The patient should never feel uncomfortably hot.

Cancer of the Lip—Report of Twenty-five Cases Treated with Radium, M. Trueheart, M. D., Sterling, Kans., the J. of the Kansas Med. Soc., Oct. 1926.

The report is based on a series of cases treated at the Sterling Hospital between August, 1922, and January, 1925. No final results are attempted.

External radiation was used on the lip, reserving the insertion of the needles for only those cases in which the glands were palpably involved. Other points in the technique are discussed. The conclusions arrived at speak for the value of radium as a curative agent, at least, as compared to other methods of treatment, and if used as the primary treatment at the time when the diagnosis can first be made. It has the advantage over other treatments of being able to salvage some of the cases that have been operated on, used paste or x ray, without cure. According to Trueheart, the most important thing in the cure of cancers of the lip or any other organ, is an early diagnosis and proper treatment early resorted to.

Treatment of Cancer of the Cervix Uteri, J. S. Ullman, M. D., Natchez, Miss. New Orleans Med. and Surg. Jour., Oct. 1926.

The first part of the paper is devoted to a plea for early recognition of cancer. This plea is directed to the physician to educate women to present themselves for treatment in time. In the light of present-day knowledge the time to cure cancer is before we are certain that it is cancer.

The majority of gynecologists are depending upon radium as the method of choice in carcinoma of the cervix uteri, as a curative agent when the patient is seen early, as a palliative measure when seen later.

The Wertheim operation yielded only 25 per cent recoveries. In the case of the simple panhysterectomy, while the operation is not so formidable, the end result is not so satisfactory. But on the other hand the application of radium does not endanger life, causes little or no discomfort, either during the time that it is in place or after the treatment, to say nothing of the short time necessary to be spent in the hospital.

Radium may either destroy the cancer cell or may restrain its growth. It also promotes the formation of fibrous tissue, which when fully organized completely encapsulates the cells, that may not have been destroyed entirely. Also in contracting, it lessens the blood supply to these cells. This is more than can be said of surgery. Whether by knife, or by the electro-cautery, if the excision leaves behind any malignant cells, we are almost certain to have metastases later.

When available the high voltage x ray, popularly known as the deep therapy treatment, should be used to cross-fire the pelvis from several different portals. This treatment used soon after the radium will in most instances take care of the metastases.

It is of the greatest importance that both patient and family physician be brought to realize the necessity of frequent and regular observation of the patient, preferably by the therapist, himself. While it is the aim of practically all radiologists today to destroy the growth by a single application this is not always accomplished, and it therefore becomes necessary that the radium be reapplied at the proper time.

Sunlight as a Disinfectant, F. M. Meader, M. D. Jour. Mich. S. M. S., Dec. 1926.

The importance of sunlight as a disinfectant has been realized for a long time, but exact knowledge as to how much power to destroy bacteria the sun's rays possessed has been a matter of conjecture. What part of the sun's rays were bactericidal has only recently been investigated. This information has not yet become general and directions have been so vague that no considerable number of medical authorities have ventured to make inteligent use of these rays. It was for information of this kind that experimental work was undertaken.

Nine experiments are detailed and charts and tables given. The literature is also reviewed. A significant statement pertaining to the nature of radiant energy is to the effect that it is propagated in the form of wave motion, and waves are transverse to the line of propagation.

A summary of the experiments is of interest.

An experiment is presented which shows that in a certain latitude, elevation, season of the year, and middle of the day, sunlight will kill staphylococcus aureus in one hour.

Again, an experiment is presented which shows that sunlight under the conditions above mentioned, and after passing through plate glass 8 mm. thick, will kill staphylococcus aureus in four and one-half hours.

Another experiment shows that indirect sunlight such as skylight from a northern exposure under the conditions of the first experiment will kill staphylococcus in about four hours.

An experiment is presented which shows that sunlight under the conditions of Experiment I during the latter part of March will become effective in killing staphylococcus aureus at about 9:00 o'clock in the morning, but has very little effect after 3 o'clock in the afternoon.

An experiment is given which shows that when an iron arc of a certain size is used as a source of light, if this light is passed through a spectroscope, and the spectrum is spread on the surface of a bacterial culture, bactericidal effect will be first noted in that part of the spectrum which is composed of wave lengths between 2300 and 2850 Angstrom units. On longer exposure longer wave lengths are noted to be effective. No longer wave length than 3100 Angstrom units was observed to be effective even after five hours' exposure.

An experiment is presented which shows that at noon of April 1st at the above mentioned elevation and place, the shortest solar wave length observed was 2995 Angstrom units. At 7:00 o'clock in the evening the shortest wave length observed was 310 Angstrom units. Since bactericidal properties of sunlight for staphylococcus aureus were not apparent after 3:30 p. m. it would appear that the effective rays in sunlight must be confined to those wave lengths which are apparent at noon, but not apparent in the late afternoon. These waves are between 2900 and 3100 Angstrom units in length.

An experiment is presented which indicates that methylene blue in acetone is bleached by the solar rays which have bactericidal activity.

The author's conclusions are also important because of their practical value and are therefore quoted.

What do the above experiments mean to the health officer? The health officer may, with confidence, rely on sunlight, and sky light to destroy bacteria if exposed to it for two hours during the middle of the day.

Withdrawing the draperies and raising the shades, even if the windows are closed, if the sun light and sky shine can enter, the destruction of bacteria will gradually be brought about.

By means of the bleaching of acetone methylene blue, the health officer may easily determine the most active periods of the day in each season of the year when the sun and sky shine may be most useful. These periods will vary with the altitude, latitude, season of the year and condition of the atmosphere. The period of the day when sunlight has bactericidal power is shorter in winter and longer in summer.

Washing the woodwork or parts of furniture likely to have become contaminated will break up covering matter which conceal bacteria, so that the sun light may become more effective.

Open books, feathers, draperies, rugs, cushions may be amply disinfected by placing out in direct sun light for two to four hours during the middle of the day. They must be so placed that the sun can have free access to their surfaces.

Health officers should interest themselves in preventing a smoke screen to come over their community. A smoke screen will deprive that community of the solar rays which destroy harmful bacteria. A smoke screen will also deprive a community of these solar rays which

stimulate nutrition in young childhood. A smokeless town will have less rickets.

Bacteria live a long time in dark rooms, hallways, and basements when they are damp. The sun can have no effect on bacteria in these places. Hence the importance of building supervision, so that buildings shall not be erected which are not adequately lighted by sunlight. Store basements cannot rely on incandescent lamps to disinfect the air and woodwork, except only as drying is useful.

The association of fluorescent substances to assist the longer light waves in the destruction of bacteria needs further research. The lethal effect of drying as produced by the infra red waves is recognized as an important means of destroying bacteria.

Radium Versus Surgery in the Pathological Uterus, W. H. Anderson, M. D. New Orleans Med. and Surg. Jour., Oct. 1926.

There is no subject of greater importance to more doctors than to know whether to operate, or not to operate, whether to use radium or not to use radium, whether to use both or neither upon the uterus that is examined by the physician almost daily.

Every stage of malignancy of the cervix is better treated by radium, unless there are complications above that prevent it, or possibly in a very young woman in the earliest stage with a very badly lacerated cervix, operation might be preferred in order to conserve the ovaries.

In the early days of radium therapy cancer of the cervix was thought of in terms of years, then later months, now weeks, and a little later perhaps it will be days and may be hours as in appendicitis, provided there may be a method of staining the cells and using the microscope without removing a section.

There is one non-malignant condition of the cervix that may be benefitted by radium, four to eight hours with 50 milligrams. This is the very large, soft, boggy, hyper-secreting cervix. In chronic endocervicitis with laceration, surgery is the preferred treatment, even the best in stubborn cases if there is no deep laceration. In applying radium to cervix, pathology of the body, fundus and appendages are to be duly considered. In a patient under 35 with involvement of one or more of those, surgery might be preferred.

In non-malignant conditions of the body or fundus of the uterus, radium is exceedingly helpful in the so-called idiopathic menorrhagias in young women, and also the dysmenorrheas both of which in many cases have an intramural fibrosis as a background. Six to eight hours with 50 milligrams in tube in the uterine canal given just after the flow stops, is quite efficacious.

The author believes that radium is being used in many non-malignant cases where surgery would serve the patient better.

Radium therapy may be supplemented to advantage in some cases with the x ray, in the advanced carcinomas of the cervix and in cases having pain in the sacral and the lumbar regions.

Irradiation of Diseased Tonsils, J. Coleman Scal, Med. J. and Rec., 124:873, Dec. 1, 1926.

This article describes a new method of treating tonsillar hypertrophies by means of Removable Radon Seeds, giving detailed reports of a series of cases where tonsillectomy was for different reasons contraindicated, and illustrating the application of the technique to varying pathological conditions.

To carry out the application of the seeds, a new implanter is used which is illustrated and described in the article.

As the pain of implantation and removal is practically *nil*, at no time is any anesthetic required, there is no need of hospitalization, nor disability of any kind. The total absence of shock is a great advantage in inoperable cases.

By means of the implanter the operator is able to place one removable Radon seed in the center of a tonsil so that radiation is distributed equally throughout. The Radon seed used is filtered by 0.3 mm. of platinum. This filtration cuts off the caustic Beta rays, thus doing away with all possibility of burning, with consequent necrosis and sloughing.

When the instrument is withdrawn after implantation the seed is left imbedded in the tonsil with a 2 cm. length of thread protruding from the portal of entry. This short thread does not in any way inconvenience the patient, no cause the slightest interference with function. At the end of four days the seeds are easily removed by grasping the thread with forceps.

The point of the trocar is so fine and the seed so small that very little trauma is done to the tonsil.

The amount of radiation can be measured with accuracy and the applicators located with such exactness as to insure equal and complete distribution throughout the tissues. Only one treatment is necessary, a fact much appreciated by the patient. Systemic reactions of any kind never occur. The attached thread, making the seed easily removable when its period of service is over, does away with an objectionable foreign body being left in the tissues—a drawback to the bare tube method. The author concludes that in the implantation of removable Platinum Radon seeds we have at present an adequate substitute for tonsillectomy in those cases where surgery is, for any reason, contraindicated.